

Programmable Automation Controllers

# **MELSEC MX Controller**

MELSEC MX Controller MX-F Model  
Programming Manual

---



# SAFETY PRECAUTIONS

---

(Read these precautions before using this product.)

Before using Mitsubishi Electric FA integrated controllers, please read the manuals for the products used and the relevant manuals carefully and pay full attention to safety to handle the products correctly.

Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

# INTRODUCTION

---

Thank you for purchasing the Mitsubishi Electric FA integrated controllers.

This manual describes the instructions and functions/function blocks required for programming.

Before using this product, please read this manual and the relevant manuals carefully and develop familiarity with the functions and performance of the controller to handle the product correctly.

When applying the program examples provided in this manual to an actual system, ensure the applicability and confirm that it will not cause system control problems.

Please make sure that the end users read this manual.



# CONTENTS

|                                       |    |
|---------------------------------------|----|
| SAFETY PRECAUTIONS .....              | 1  |
| INTRODUCTION .....                    | 2  |
| RELEVANT MANUALS .....                | 21 |
| TERMS .....                           | 22 |
| GENERIC TERMS AND ABBREVIATIONS ..... | 25 |

## PART 1 PROGRAMMING OVERVIEW

|                                                                                                         |           |
|---------------------------------------------------------------------------------------------------------|-----------|
| <b>CHAPTER 1 OVERVIEW</b> .....                                                                         | <b>28</b> |
| 1.1 Instruction Configuration .....                                                                     | 28        |
| 1.2 Data Specification Method .....                                                                     | 30        |
| Bit data .....                                                                                          | 33        |
| 16-bit data (word data) .....                                                                           | 34        |
| 32-bit data (double word data) .....                                                                    | 36        |
| Real number data (floating-point data) .....                                                            | 39        |
| String data .....                                                                                       | 42        |
| 1.3 Execution Condition .....                                                                           | 44        |
| 1.4 Precautions on Programming .....                                                                    | 45        |
| Errors common to instructions .....                                                                     | 45        |
| Checking the ranges of instruction runtime devices and labels .....                                     | 45        |
| Operation when a long timer or long retentive timer device is used .....                                | 51        |
| Precautions for using a link device assigned to a synchronized station as an instruction argument ..... | 53        |
| Operations arising when the OUT, SET/RST, and PLS/PLF instructions of the same device are used .....    | 53        |
| Restrictions on using file registers .....                                                              | 59        |
| <b>CHAPTER 2 PROGRAM ORGANIZATION UNITS</b> .....                                                       | <b>60</b> |
| 2.1 Program Blocks .....                                                                                | 61        |
| 2.2 Functions (FUN) .....                                                                               | 62        |
| 2.3 Function Blocks (FB) .....                                                                          | 66        |
| 2.4 Precautions .....                                                                                   | 77        |
| When a function is used .....                                                                           | 77        |
| When a function block is used .....                                                                     | 77        |
| Operations of when the MC/MCR instructions are used to control EN .....                                 | 81        |
| <b>CHAPTER 3 LADDER DIAGRAM</b> .....                                                                   | <b>86</b> |
| 3.1 Configuration .....                                                                                 | 86        |
| Ladder symbols .....                                                                                    | 86        |
| Program execution order .....                                                                           | 87        |
| Precautions for using a function block in ladder diagram .....                                          | 88        |
| 3.2 Inline ST .....                                                                                     | 89        |
| 3.3 Statements and Notes .....                                                                          | 91        |
| <b>CHAPTER 4 STRUCTURED TEXT LANGUAGE</b> .....                                                         | <b>92</b> |
| 4.1 Configuration .....                                                                                 | 93        |
| Delimiter .....                                                                                         | 94        |
| Operators .....                                                                                         | 94        |
| Instruction .....                                                                                       | 95        |

|                          |     |
|--------------------------|-----|
| Control statements ..... | 96  |
| Constants .....          | 106 |
| Labels and devices ..... | 107 |
| Comments .....           | 109 |

## **CHAPTER 5 FBD/LD 110**

|                                           |            |
|-------------------------------------------|------------|
| <b>5.1 Configuration .....</b>            | <b>110</b> |
| Program elements .....                    | 111        |
| Constant .....                            | 118        |
| Labels and devices .....                  | 118        |
| <b>5.2 Inline ST .....</b>                | <b>120</b> |
| <b>5.3 Program Execution Order .....</b>  | <b>121</b> |
| Execution order of program elements ..... | 121        |

## **PART 2 LISTS OF INSTRUCTIONS AND FUN/FB**

### **CHAPTER 6 INSTRUCTION LIST 124**

|                                                                  |            |
|------------------------------------------------------------------|------------|
| <b>6.1 Sequence Instructions .....</b>                           | <b>124</b> |
| <b>6.2 Basic Instructions .....</b>                              | <b>128</b> |
| <b>6.3 Application Instructions .....</b>                        | <b>146</b> |
| Program control .....                                            | 146        |
| Data processing .....                                            | 148        |
| Debugging and failure diagnostic .....                           | 156        |
| String processing .....                                          | 156        |
| Real value processing .....                                      | 159        |
| Random number .....                                              | 167        |
| Device operation .....                                           | 168        |
| Timer, counter .....                                             | 169        |
| Clock .....                                                      | 171        |
| Module access .....                                              | 175        |
| PID operation instruction .....                                  | 176        |
| PID control instructions .....                                   | 176        |
| High-speed I/O control instructions .....                        | 177        |
| Dedicated instructions for the positioning function .....        | 178        |
| Dedicated instructions for the high-speed counter function ..... | 179        |
| Pulse related instructions .....                                 | 179        |

### **CHAPTER 7 NETWORK INSTRUCTION LIST 180**

|                                                             |            |
|-------------------------------------------------------------|------------|
| <b>7.1 Ethernet Instructions .....</b>                      | <b>180</b> |
| <b>7.2 External Device Communication Instructions .....</b> | <b>182</b> |

### **CHAPTER 8 STANDARD FUNCTION/STANDARD FUNCTION BLOCK LISTS 183**

|                                           |            |
|-------------------------------------------|------------|
| <b>8.1 Standard Functions .....</b>       | <b>183</b> |
| <b>8.2 Standard Function Blocks .....</b> | <b>194</b> |

### **CHAPTER 9 MOTION CONTROL FUNCTION BLOCK LIST 196**

|                                                 |            |
|-------------------------------------------------|------------|
| <b>9.1 Administrative Function Blocks .....</b> | <b>196</b> |
| <b>9.2 Motion Function Blocks .....</b>         | <b>199</b> |
| <b>9.3 Standard Function Blocks .....</b>       | <b>202</b> |

## CHAPTER 10 NETWORK FUNCTION BLOCK LIST 203

|      |                                    |     |
|------|------------------------------------|-----|
| 10.1 | Function Blocks for Ethernet       | 203 |
| 10.2 | Function Blocks for CC-Link IE TSN | 204 |

## PART 3 SEQUENCE INSTRUCTIONS/ BASIC INSTRUCTIONS

## CHAPTER 11 SEQUENCE INSTRUCTIONS 206

|      |                                                                                       |     |
|------|---------------------------------------------------------------------------------------|-----|
| 11.1 | <b>Contact Instructions</b>                                                           | 206 |
|      | Operation start, series connection, parallel connection                               | 206 |
|      | Pulse operation start, pulse series connection, pulse parallel connection             | 208 |
|      | Pulse NOT operation start, pulse NOT series connection, pulse NOT parallel connection | 211 |
| 11.2 | <b>Association Instructions</b>                                                       | 214 |
|      | Ladder block series/parallel connection                                               | 214 |
|      | Inverting the operation result                                                        | 215 |
|      | Converting the operation result into a pulse                                          | 216 |
|      | Converting the edge relay operation result into a pulse                               | 217 |
| 11.3 | <b>Output Instructions</b>                                                            | 219 |
|      | Out (excluding the timer, counter, and annunciator)                                   | 219 |
|      | Timer                                                                                 | 221 |
|      | Long timer                                                                            | 224 |
|      | Counter                                                                               | 227 |
|      | Long counter                                                                          | 229 |
|      | Annunciator                                                                           | 231 |
|      | Setting devices (excluding annunciator)                                               | 232 |
|      | Resetting devices (excluding annunciator)                                             | 234 |
|      | Setting annunciator                                                                   | 236 |
|      | Resetting annunciator                                                                 | 238 |
|      | Rising edge output                                                                    | 240 |
|      | Falling edge output                                                                   | 242 |
|      | Inverting the bit device output                                                       | 244 |
|      | Converting the direct access output into a pulse                                      | 245 |
| 11.4 | <b>Shift Instructions</b>                                                             | 247 |
|      | Shifting bit devices                                                                  | 247 |
| 11.5 | <b>Master Control Instructions</b>                                                    | 249 |
|      | Setting/resetting a master control                                                    | 249 |
| 11.6 | <b>Termination Instructions</b>                                                       | 253 |
|      | Ending the main routine program                                                       | 253 |
|      | Ending the sequence program                                                           | 254 |
| 11.7 | <b>Stop Instruction</b>                                                               | 256 |
|      | Stopping the sequence program                                                         | 256 |
| 11.8 | <b>No Operation Instruction</b>                                                       | 257 |
|      | No operation (NOPLF)                                                                  | 257 |

## CHAPTER 12 BASIC INSTRUCTIONS 258

|      |                                          |     |
|------|------------------------------------------|-----|
| 12.1 | <b>Comparison Operation Instructions</b> | 258 |
|      | Comparing 16-bit binary data             | 258 |
|      | Comparing 32-bit binary data             | 260 |
|      | Comparing 16-bit binary block data       | 262 |

|             |                                                                |            |
|-------------|----------------------------------------------------------------|------------|
|             | Comparing 32-bit binary block data . . . . .                   | 265        |
| <b>12.2</b> | <b>Arithmetic Operation Instructions . . . . .</b>             | <b>268</b> |
|             | Adding 16-bit binary data . . . . .                            | 268        |
|             | Subtracting 16-bit binary data . . . . .                       | 272        |
|             | Adding 32-bit binary data . . . . .                            | 276        |
|             | Subtracting 32-bit binary data . . . . .                       | 280        |
|             | Multiplying 16-bit binary data . . . . .                       | 284        |
|             | Dividing 16-bit binary data . . . . .                          | 286        |
|             | Multiplying 32-bit binary data . . . . .                       | 288        |
|             | Dividing 32-bit binary data . . . . .                          | 290        |
|             | Adding BCD 4-digit data . . . . .                              | 292        |
|             | Subtracting BCD 4-digit data . . . . .                         | 295        |
|             | Adding BCD 8-digit data . . . . .                              | 298        |
|             | Subtracting BCD 8-digit data . . . . .                         | 301        |
|             | Multiplying BCD 4-digit data . . . . .                         | 305        |
|             | Dividing BCD 4-digit data . . . . .                            | 307        |
|             | Multiplying BCD 8-digit data . . . . .                         | 309        |
|             | Dividing BCD 8-digit data . . . . .                            | 311        |
|             | Adding 16-bit binary block data . . . . .                      | 313        |
|             | Subtracting 16-bit binary block data . . . . .                 | 315        |
|             | Adding 32-bit binary block data . . . . .                      | 317        |
|             | Subtracting 32-bit binary block data . . . . .                 | 320        |
|             | Incrementing 16-bit binary data . . . . .                      | 323        |
|             | Decrementing 16-bit binary data . . . . .                      | 324        |
|             | Incrementing 32-bit binary data . . . . .                      | 325        |
|             | Decrementing 32-bit binary data . . . . .                      | 326        |
| <b>12.3</b> | <b>Logical Operation Instructions . . . . .</b>                | <b>327</b> |
|             | Performing an AND operation on 16-bit data . . . . .           | 327        |
|             | Performing an AND operation on 32-bit data . . . . .           | 330        |
|             | Performing an AND operation on 16-bit block data . . . . .     | 334        |
|             | Performing an OR operation on 16-bit data . . . . .            | 336        |
|             | Performing an OR operation on 32-bit data . . . . .            | 339        |
|             | Performing an OR operation on 16-bit block data . . . . .      | 343        |
|             | Performing an XOR operation on 16-bit data . . . . .           | 345        |
|             | Performing an XOR operation on 32-bit data . . . . .           | 348        |
|             | Performing an XOR operation on 16-bit block data . . . . .     | 352        |
|             | Performing an XNOR operation on 16-bit data . . . . .          | 354        |
|             | Performing an XNOR operation on 32-bit data . . . . .          | 357        |
|             | Performing an XNOR operation on 16-bit block data . . . . .    | 361        |
| <b>12.4</b> | <b>Bit Processing Instructions . . . . .</b>                   | <b>363</b> |
|             | Setting a bit in the word device . . . . .                     | 363        |
|             | Resetting a bit in the word device . . . . .                   | 365        |
|             | Performing a 16-bit test . . . . .                             | 366        |
|             | Performing a 32-bit test . . . . .                             | 368        |
|             | Batch-resetting bit devices . . . . .                          | 370        |
| <b>12.5</b> | <b>Shift Instructions . . . . .</b>                            | <b>372</b> |
|             | Shifting 16-bit binary data to the right by n bit(s) . . . . . | 372        |
|             | Shifting 16-bit binary data to the left by n bit(s) . . . . .  | 374        |
|             | Shifting n-bit data to the right by one bit . . . . .          | 376        |
|             | Shifting n-bit data to the left by one bit . . . . .           | 378        |
|             | Shifting n-word data to the right by one word . . . . .        | 380        |

|                                                                                  |            |
|----------------------------------------------------------------------------------|------------|
| Shifting n-word data to the left by one word . . . . .                           | 382        |
| Shifting n-bit data to the right by n bit(s) . . . . .                           | 384        |
| Shifting n-bit data to the left by n bit(s) . . . . .                            | 386        |
| Shifting n-word data to the right by n word(s) . . . . .                         | 388        |
| Shifting n-word data to the left by n word(s) . . . . .                          | 390        |
| <b>12.6 Data Conversion Instructions . . . . .</b>                               | <b>392</b> |
| Converting binary data to BCD 4-digit data . . . . .                             | 392        |
| Converting binary data to BCD 8-digit data . . . . .                             | 394        |
| Converting BCD 4-digit data to 16-bit binary data . . . . .                      | 396        |
| Converting BCD 8-digit data to 32-bit binary data . . . . .                      | 398        |
| Converting single-precision real number to 16-bit signed binary data . . . . .   | 400        |
| Converting single-precision real number to 16-bit unsigned binary data . . . . . | 402        |
| Converting single-precision real number to 32-bit signed binary data . . . . .   | 404        |
| Converting single-precision real number to 32-bit unsigned binary data . . . . . | 406        |
| Converting double-precision real number to 16-bit signed binary data . . . . .   | 408        |
| Converting double-precision real number to 16-bit unsigned binary data . . . . . | 410        |
| Converting double-precision real number to 32-bit signed binary data . . . . .   | 412        |
| Converting double-precision real number to 32-bit unsigned binary data . . . . . | 414        |
| Converting 16-bit signed binary data to 16-bit unsigned binary data . . . . .    | 416        |
| Converting 16-bit signed binary data to 32-bit signed binary data . . . . .      | 418        |
| Converting 16-bit signed binary data to 32-bit unsigned binary data . . . . .    | 420        |
| Converting 16-bit unsigned binary data to 16-bit signed binary data . . . . .    | 422        |
| Converting 16-bit unsigned binary data to 32-bit signed binary data . . . . .    | 424        |
| Converting 16-bit unsigned binary data to 32-bit unsigned binary data . . . . .  | 426        |
| Converting 32-bit signed binary data to 16-bit signed binary data . . . . .      | 428        |
| Converting 32-bit signed binary data to 16-bit unsigned binary data . . . . .    | 430        |
| Converting 32-bit signed binary data to 32-bit unsigned binary data . . . . .    | 432        |
| Converting 32-bit unsigned binary data to 16-bit signed binary data . . . . .    | 434        |
| Converting 32-bit unsigned binary data to 16-bit unsigned binary data . . . . .  | 436        |
| Converting 32-bit unsigned binary data to 32-bit signed binary data . . . . .    | 438        |
| Converting 16-bit binary data to Gray code data . . . . .                        | 440        |
| Converting 32-bit binary data to Gray code data . . . . .                        | 442        |
| Converting 16-bit binary Gray code data to 16-bit binary data . . . . .          | 444        |
| Converting 32-bit binary Gray code data to 32-bit binary data . . . . .          | 446        |
| Converting 16-bit binary data block to BCD 4-digit data block . . . . .          | 448        |
| Converting BCD 4-digit block data to 16-bit binary block data . . . . .          | 450        |
| Converting decimal ASCII data to 16-bit binary data . . . . .                    | 452        |
| Converting decimal ASCII data to 32-bit binary data . . . . .                    | 455        |
| Converting hexadecimal ASCII data to 16-bit binary data . . . . .                | 459        |
| Converting hexadecimal ASCII data to 32-bit binary data . . . . .                | 462        |
| Converting decimal ASCII data to BCD 4-digit data . . . . .                      | 465        |
| Converting decimal ASCII data to BCD 8-digit data . . . . .                      | 468        |
| Converting decimal string data to 16-bit binary data . . . . .                   | 471        |
| Converting decimal string data to 32-bit binary data . . . . .                   | 474        |
| Converting hexadecimal ASCII to hexadecimal binary data . . . . .                | 477        |
| Converting single-precision real number to BCD format data . . . . .             | 479        |
| Two's complement of 16-bit binary data (sign inversion) . . . . .                | 481        |
| Two's complement of 32-bit binary data (sign inversion) . . . . .                | 482        |
| Decoding 8-bit data to 256-bit data . . . . .                                    | 483        |
| Encoding 256-bit data to 8-bit data . . . . .                                    | 485        |
| Decoding data to seven-segment display data . . . . .                            | 487        |

|                                                                     |            |
|---------------------------------------------------------------------|------------|
| Separating data in units of 4 bits . . . . .                        | 490        |
| Combining data in units of 4 bits . . . . .                         | 492        |
| Separating data in units of bits . . . . .                          | 494        |
| Combining data in units of bits . . . . .                           | 496        |
| Separating data in units of bytes . . . . .                         | 498        |
| Combining data in units of bytes . . . . .                          | 500        |
| <b>12.7 Data Transfer Instructions . . . . .</b>                    | <b>502</b> |
| Transferring 16-bit binary data . . . . .                           | 502        |
| Transferring 32-bit binary data . . . . .                           | 504        |
| Inverting and transferring 16-bit binary data . . . . .             | 506        |
| Inverting and transferring 32-bit binary data . . . . .             | 508        |
| Inverting and transferring 1-bit data. . . . .                      | 510        |
| Transferring 16-bit binary data block (16 bits). . . . .            | 512        |
| Transferring 16-bit binary data block (32 bits). . . . .            | 514        |
| Transferring the same 16-bit binary data block (16 bits). . . . .   | 516        |
| Transferring the same 16-bit binary data block (32 bits). . . . .   | 518        |
| Transferring the same 32-bit binary data block (16 bits). . . . .   | 520        |
| Transferring the same 32-bit binary data block (32 bits). . . . .   | 522        |
| Exchanging 16-bit binary data. . . . .                              | 524        |
| Exchanging 32-bit binary data. . . . .                              | 525        |
| Exchanging 16-bit binary block data . . . . .                       | 526        |
| Exchanging the upper and lower bytes of 16-bit binary data. . . . . | 528        |
| Exchanging the upper and lower bytes of 32-bit binary data. . . . . | 529        |
| Transferring 1-bit data . . . . .                                   | 530        |
| Transferring n-bit data . . . . .                                   | 531        |

## PART 4 APPLICATION INSTRUCTIONS

|                                                                                                 |            |
|-------------------------------------------------------------------------------------------------|------------|
| <b>CHAPTER 13 PROGRAM CONTROL . . . . .</b>                                                     | <b>534</b> |
| <b>13.1 Program Branch Instructions. . . . .</b>                                                | <b>534</b> |
| Pointer branch . . . . .                                                                        | 534        |
| Jumping to END . . . . .                                                                        | 537        |
| <b>13.2 Program Execution Control Instructions . . . . .</b>                                    | <b>538</b> |
| Disabling/enabling interrupt programs. . . . .                                                  | 538        |
| Disabling interrupt programs with specified priority or lower . . . . .                         | 542        |
| Interrupt program mask . . . . .                                                                | 547        |
| Disabling/enabling the specified interrupt pointer . . . . .                                    | 549        |
| Returning from the interrupt program . . . . .                                                  | 551        |
| Resetting the watchdog timer . . . . .                                                          | 552        |
| <b>13.3 Structure Creation Instructions . . . . .</b>                                           | <b>553</b> |
| Performing the FOR to NEXT instruction loop. . . . .                                            | 553        |
| Forcibly terminating the FOR to NEXT instruction loop. . . . .                                  | 556        |
| Calling a subroutine program . . . . .                                                          | 558        |
| Returning from the subroutine program called . . . . .                                          | 564        |
| Calling a subroutine program and turning the output off . . . . .                               | 565        |
| Calling a subroutine program in the specified program file . . . . .                            | 571        |
| Calling a subroutine program in the specified program file and turning the output off . . . . . | 578        |
| Calling a subroutine program . . . . .                                                          | 583        |

|                                                        |            |
|--------------------------------------------------------|------------|
| <b>CHAPTER 14 DATA PROCESSING</b>                      | <b>588</b> |
| <b>14.1 Rotation Instructions</b>                      | <b>588</b> |
| Rotating 16-bit binary data to the right               | 588        |
| Rotating 16-bit binary data to the left                | 591        |
| Rotating 32-bit binary data to the right               | 594        |
| Rotating 32-bit binary data to the left                | 596        |
| <b>14.2 Data Table Operation Instructions</b>          | <b>598</b> |
| Reading the oldest data from the data table            | 598        |
| Reading the newest data from the data table            | 600        |
| Writing data to the data table                         | 602        |
| Inserting data to the data table                       | 604        |
| Deleting data from data table                          | 606        |
| <b>14.3 Reading/Writing Data Instructions</b>          | <b>608</b> |
| Reading data from the data memory                      | 609        |
| Writing data to the data memory                        | 611        |
| <b>14.4 File Operation Instructions</b>                | <b>614</b> |
| Reading data from the specified file                   | 614        |
| Writing data to the specified file                     | 630        |
| Deleting the specified file                            | 644        |
| Copying the specified file                             | 647        |
| Moving the specified file                              | 652        |
| Renaming the specified file                            | 657        |
| Acquiring the status of the specified file             | 660        |
| Error codes generated for file operation instructions  | 663        |
| <b>14.5 Data Control Instructions</b>                  | <b>664</b> |
| Upper and lower limit control of 16-bit binary data    | 664        |
| Upper and lower limit control of 32-bit binary data    | 666        |
| Dead band control of 16-bit binary data                | 668        |
| Dead band control of 32-bit binary data                | 670        |
| Zone control of 16-bit binary data                     | 672        |
| Zone control of 32-bit binary data                     | 674        |
| Scaling 16-bit binary data (point coordinates)         | 676        |
| Scaling 32-bit binary data (point coordinates)         | 679        |
| Scaling 16-bit binary data (XY coordinates)            | 682        |
| Scaling 32-bit binary data (XY coordinates)            | 684        |
| <b>14.6 Data Processing Instructions</b>               | <b>686</b> |
| Searching 16-bit binary data                           | 686        |
| Searching 32-bit binary data                           | 688        |
| Searching 16-bit binary data (minimum, match, maximum) | 690        |
| Searching 32-bit binary data (minimum, match, maximum) | 692        |
| Checking 16-bit binary data                            | 694        |
| Checking 32-bit binary data                            | 695        |
| Searching the maximum value of 16-bit binary data      | 696        |
| Searching the maximum value of 32-bit binary data      | 698        |
| Searching the minimum value of 16-bit binary data      | 700        |
| Searching the minimum value of 32-bit binary data      | 702        |
| Sorting 16-bit binary data                             | 704        |
| Sorting 32-bit binary data                             | 706        |
| Adding 16-bit binary data                              | 708        |
| Adding 32-bit binary data                              | 710        |

|                                                            |     |
|------------------------------------------------------------|-----|
| Calculating the mean value of 16-bit binary data . . . . . | 712 |
| Calculating the mean value of 32-bit binary data . . . . . | 714 |
| Calculating the square root of 16-bit binary data. . . . . | 716 |
| Calculating the square root of 32-bit binary data. . . . . | 717 |
| CRC operation. . . . .                                     | 718 |

---

## **CHAPTER 15 DEBUGGING AND FAILURE DIAGNOSTIC** **720**

---

|                                                                    |            |
|--------------------------------------------------------------------|------------|
| <b>15.1 Debugging and Failure Diagnostic Instructions. . . . .</b> | <b>720</b> |
| Resetting the error display and the annunciator display . . . . .  | 720        |

---

## **CHAPTER 16 STRING PROCESSING** **722**

---

|                                                                                   |            |
|-----------------------------------------------------------------------------------|------------|
| <b>16.1 String Processing Instructions . . . . .</b>                              | <b>722</b> |
| Comparing string data . . . . .                                                   | 722        |
| Concatenating string data . . . . .                                               | 725        |
| Transferring string data . . . . .                                                | 729        |
| Transferring Unicode string data . . . . .                                        | 731        |
| Converting 16-bit binary data to decimal ASCII. . . . .                           | 733        |
| Converting 32-bit binary data to decimal ASCII. . . . .                           | 737        |
| Converting 16-bit binary data to hexadecimal ASCII. . . . .                       | 742        |
| Converting 32-bit binary data to hexadecimal ASCII. . . . .                       | 746        |
| Converting 16-bit binary data to string data. . . . .                             | 750        |
| Converting 32-bit binary data to string data. . . . .                             | 753        |
| Converting BCD 4-digit data to decimal ASCII code . . . . .                       | 756        |
| Converting BCD 8-digit data to decimal ASCII code . . . . .                       | 760        |
| Converting single-precision real number to string data. . . . .                   | 765        |
| Converting hexadecimal binary data to hexadecimal ASCII code. . . . .             | 770        |
| Converting and concatenating multiple data strings . . . . .                      | 772        |
| Converting Unicode string to Shift JIS string . . . . .                           | 789        |
| Converting Shift JIS string to Unicode string (without byte order mark) . . . . . | 791        |
| Converting shift JIS string to Unicode (with byte order mark) . . . . .           | 793        |
| Detecting a string length . . . . .                                               | 795        |
| Extracting string data from the right. . . . .                                    | 797        |
| Extracting string data from the left. . . . .                                     | 799        |
| Extracting the specified string data . . . . .                                    | 801        |
| Replacing the specified string data . . . . .                                     | 803        |
| Searching string data. . . . .                                                    | 806        |
| Inserting string data. . . . .                                                    | 808        |
| Deleting string data . . . . .                                                    | 810        |

---

## **CHAPTER 17 REAL VALUE PROCESSING** **812**

---

|                                                     |            |
|-----------------------------------------------------|------------|
| <b>17.1 Floating-point Instruction. . . . .</b>     | <b>812</b> |
| Comparing single-precision real numbers. . . . .    | 812        |
| Comparing double-precision real numbers . . . . .   | 814        |
| Adding single-precision real numbers . . . . .      | 817        |
| Subtracting single-precision real numbers . . . . . | 821        |
| Adding double-precision real numbers . . . . .      | 825        |
| Subtracting double-precision real numbers. . . . .  | 829        |
| Multiplying single-precision real numbers . . . . . | 833        |
| Dividing single-precision real numbers . . . . .    | 835        |
| Multiplying double-precision real numbers . . . . . | 837        |



|                                                                                   |     |
|-----------------------------------------------------------------------------------|-----|
| Dividing double-precision real numbers . . . . .                                  | 839 |
| Converting 16-bit signed binary data to single-precision real number. . . . .     | 841 |
| Converting 16-bit unsigned binary data to single-precision real number. . . . .   | 842 |
| Converting 32-bit signed binary data to single-precision real number. . . . .     | 843 |
| Converting 32-bit unsigned binary data to single-precision real number. . . . .   | 845 |
| Converting double-precision real number to single-precision real number . . . . . | 847 |
| Converting 16-bit signed binary data to double-precision real number . . . . .    | 849 |
| Converting 16-bit unsigned binary data to double-precision real number . . . . .  | 850 |
| Converting 32-bit signed binary data to double-precision real number . . . . .    | 851 |
| Converting 32-bit unsigned binary data to double-precision real number . . . . .  | 852 |
| Converting single-precision real number to double-precision real number . . . . . | 853 |
| Converting string data to single-precision real number . . . . .                  | 855 |
| Converting BCD format data to single-precision real number . . . . .              | 860 |
| Inverting the sign of single-precision real number . . . . .                      | 862 |
| Inverting the sign of double-precision real number . . . . .                      | 863 |
| Transferring single-precision real number . . . . .                               | 864 |
| Transferring double-precision real number . . . . .                               | 865 |
| Calculating the sine of single-precision real number . . . . .                    | 866 |
| Calculating the cosine of single-precision real number . . . . .                  | 868 |
| Calculating the tangent of single-precision real number . . . . .                 | 870 |
| Calculating the arc sine of single-precision real number . . . . .                | 872 |
| Calculating the arc cosine of single-precision real number . . . . .              | 874 |
| Calculating the arc tangent of single-precision real number . . . . .             | 876 |
| Calculating the sine of double-precision real number . . . . .                    | 878 |
| Calculating the cosine of double-precision real number . . . . .                  | 880 |
| Calculating the tangent of double-precision real number . . . . .                 | 882 |
| Calculating the arc sine of double-precision real number . . . . .                | 884 |
| Calculating the arc cosine of double-precision real number . . . . .              | 886 |
| Calculating the arc tangent of double-precision real number . . . . .             | 888 |
| Calculating the sine of BCD data . . . . .                                        | 890 |
| Calculating the cosine of BCD data . . . . .                                      | 892 |
| Calculating the tangent of BCD data . . . . .                                     | 894 |
| Calculating the arc sine of BCD data . . . . .                                    | 896 |
| Calculating the arc cosine of BCD data . . . . .                                  | 898 |
| Calculating the arc tangent of BCD data . . . . .                                 | 900 |
| Converting single-precision real number angle to radian . . . . .                 | 902 |
| Converting single-precision real number radian to angle . . . . .                 | 904 |
| Converting double-precision real number angle to radian . . . . .                 | 906 |
| Converting double-precision real number radian to angle . . . . .                 | 908 |
| Calculating the square root of single-precision real number . . . . .             | 910 |
| Calculating the square root of double-precision real number . . . . .             | 912 |
| Calculating the exponent of single-precision real number . . . . .                | 914 |
| Calculating the exponent of double-precision real number . . . . .                | 916 |
| Calculating the natural logarithm of single-precision real number . . . . .       | 918 |
| Calculating the natural logarithm of double-precision real number . . . . .       | 920 |
| Calculating the square root of BCD 4-digit data . . . . .                         | 922 |
| Calculating the square root of BCD 8-digit data . . . . .                         | 924 |
| Calculating the exponentiation of single-precision real number . . . . .          | 926 |
| Calculating the exponentiation of double-precision real number . . . . .          | 928 |
| Calculating the common logarithm of single-precision real number . . . . .        | 930 |
| Calculating the common logarithm of double-precision real number . . . . .        | 932 |

|                                                                       |     |
|-----------------------------------------------------------------------|-----|
| Searching the maximum value of single-precision real number . . . . . | 934 |
| Searching the maximum value of double-precision real number. . . . .  | 936 |
| Searching the minimum value of single-precision real number . . . . . | 938 |
| Searching the minimum value of double-precision real number . . . . . | 940 |

---

## **CHAPTER 18 RANDOM NUMBER** **942**

---

|                                                  |            |
|--------------------------------------------------|------------|
| <b>18.1 Random Number Instructions . . . . .</b> | <b>942</b> |
| Generating random number . . . . .               | 942        |
| Changing random sequence . . . . .               | 943        |

---

## **CHAPTER 19 DEVICE OPERATION** **944**

---

|                                                                                    |            |
|------------------------------------------------------------------------------------|------------|
| <b>19.1 Index Register Instructions . . . . .</b>                                  | <b>944</b> |
| Saving all data of the index register . . . . .                                    | 944        |
| Returning all data of the index register . . . . .                                 | 947        |
| Saving the selected data of the index register and long index register . . . . .   | 948        |
| Returning the selected data of the index register and long index register. . . . . | 952        |
| <b>19.2 File Register Operation Instructions . . . . .</b>                         | <b>954</b> |
| Switching the file register block number . . . . .                                 | 954        |
| <b>19.3 File Register Read/Write Instructions . . . . .</b>                        | <b>956</b> |
| Reading 1-byte data from the file register . . . . .                               | 956        |
| Writing 1-byte data to the file register . . . . .                                 | 958        |
| <b>19.4 Indirect Address Read Instructions . . . . .</b>                           | <b>961</b> |
| Reading the indirect address. . . . .                                              | 961        |

---

## **CHAPTER 20 TIMER, COUNTER** **963**

---

|                                                                 |            |
|-----------------------------------------------------------------|------------|
| <b>20.1 Special Counter Instructions . . . . .</b>              | <b>963</b> |
| Counting up or down the current value (1-phase input) . . . . . | 963        |
| Counting up or down the current value (2-phase input) . . . . . | 965        |
| <b>20.2 Special Timer Instructions . . . . .</b>                | <b>967</b> |
| Teaching timer . . . . .                                        | 967        |
| Special function timer . . . . .                                | 969        |

---

## **CHAPTER 21 CLOCK** **972**

---

|                                                                     |             |
|---------------------------------------------------------------------|-------------|
| <b>21.1 Clock Instructions . . . . .</b>                            | <b>972</b>  |
| Reading clock data . . . . .                                        | 972         |
| Writing clock data . . . . .                                        | 974         |
| Adding clock data . . . . .                                         | 976         |
| Subtracting clock data . . . . .                                    | 978         |
| Converting time data from hour/minute/second to second . . . . .    | 980         |
| Converting time data from second to hour/minute/second . . . . .    | 982         |
| Converting date and time data from date and time to second. . . . . | 984         |
| Converting date and time data from second to date and time. . . . . | 986         |
| Comparing date data . . . . .                                       | 988         |
| Comparing time data . . . . .                                       | 992         |
| Outputting a comparison result of time data . . . . .               | 995         |
| Reading expansion clock data. . . . .                               | 997         |
| Adding expansion clock data. . . . .                                | 999         |
| Subtracting expansion clock data . . . . .                          | 1001        |
| <b>21.2 Timing Check Instructions . . . . .</b>                     | <b>1003</b> |
| Generating timing pulses. . . . .                                   | 1003        |

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| Measuring time of the specified data . . . . .                                  | 1005        |
| <b>CHAPTER 22 MODULE ACCESS</b>                                                 | <b>1007</b> |
| <b>22.1 Module Access Instructions . . . . .</b>                                | <b>1007</b> |
| Performing I/O refresh . . . . .                                                | 1007        |
| Reading 1-word/2-word data from another module (16-bit specification) . . . . . | 1009        |
| Writing 1-word/2-word data to a module (16-bit specification) . . . . .         | 1012        |
| Reading 1-word/2-word data from another module (32-bit specification) . . . . . | 1017        |
| Writing 1-word/2-word data to a module (32-bit specification) . . . . .         | 1021        |
| Reading module specific information . . . . .                                   | 1025        |
| <b>CHAPTER 23 PID OPERATION INSTRUCTION</b>                                     | <b>1029</b> |
| <b>23.1 Overview . . . . .</b>                                                  | <b>1029</b> |
| Control data . . . . .                                                          | 1031        |
| Auto tuning . . . . .                                                           | 1039        |
| <b>23.2 PID Operation Instruction . . . . .</b>                                 | <b>1041</b> |
| <b>CHAPTER 24 PID CONTROL INSTRUCTIONS</b>                                      | <b>1045</b> |
| <b>24.1 Overview . . . . .</b>                                                  | <b>1045</b> |
| Operation method . . . . .                                                      | 1045        |
| PID control procedure . . . . .                                                 | 1046        |
| Helpful functions . . . . .                                                     | 1052        |
| <b>24.2 PID Control Instructions (Inexact Differential) . . . . .</b>           | <b>1054</b> |
| Registering the PID control data to the controller . . . . .                    | 1056        |
| Performing PID operation . . . . .                                              | 1059        |
| Stopping the operation of specified loop number . . . . .                       | 1062        |
| Starting the operation of specified loop number . . . . .                       | 1063        |
| Changing the parameters of specified loop number . . . . .                      | 1064        |
| <b>24.3 PID Control Instructions (Exact Differential) . . . . .</b>             | <b>1066</b> |
| Registering the PID control data to the controller . . . . .                    | 1068        |
| Performing PID operation . . . . .                                              | 1070        |
| Stopping the operation of specified loop number . . . . .                       | 1073        |
| Starting the operation of specified loop number . . . . .                       | 1074        |
| Changing the parameters of specified loop number . . . . .                      | 1075        |
| <b>CHAPTER 25 HIGH-SPEED I/O CONTROL INSTRUCTIONS</b>                           | <b>1077</b> |
| <b>25.1 Start/Stop of High-Speed I/O . . . . .</b>                              | <b>1077</b> |
| Start/stop of the 16-bit data high-speed I/O function . . . . .                 | 1077        |
| Start/stop of the 32-bit data high-speed I/O function . . . . .                 | 1080        |
| <b>CHAPTER 26 DEDICATED INSTRUCTIONS (POSITIONING FUNCTION)</b>                 | <b>1083</b> |
| <b>26.1 Mechanical OPR . . . . .</b>                                            | <b>1083</b> |
| <b>26.2 Interrupt 1-speed Positioning . . . . .</b>                             | <b>1090</b> |
| <b>26.3 Variable Speed Operation . . . . .</b>                                  | <b>1096</b> |
| <b>26.4 1-speed Positioning (Relative) . . . . .</b>                            | <b>1101</b> |
| <b>26.5 1-speed Positioning (Absolute) . . . . .</b>                            | <b>1106</b> |
| <b>26.6 Table Operation (Multiple Tables) . . . . .</b>                         | <b>1111</b> |
| <b>26.7 Interrupt Input 1 Trigger . . . . .</b>                                 | <b>1113</b> |
| <b>26.8 Restoring the Absolute Position . . . . .</b>                           | <b>1116</b> |

---

**CHAPTER 27 HIGH-SPEED COUNTER FUNCTION DEDICATED INSTRUCTIONS 1119**

---

|                                                     |             |
|-----------------------------------------------------|-------------|
| <b>27.1 High-speed IO SM/SD Read/Write (Update)</b> | <b>1119</b> |
| 16-bit data read/write (update)                     | 1119        |
| 32-bit data read/write (update)                     | 1122        |

---

**CHAPTER 28 PULSE RELATED INSTRUCTIONS 1124**

---

|                                                                         |             |
|-------------------------------------------------------------------------|-------------|
| <b>28.1 16 Bit Binary/32 Bit Binary Pulse Width Modulation</b>          | <b>1124</b> |
| 16 bit binary pulse width modulation                                    | 1124        |
| 32 bit binary pulse width modulation                                    | 1131        |
| <b>28.2 Measuring the Density of 16 Bit Binary/32 Bit Binary Pulses</b> | <b>1138</b> |
| Measuring the density of 16 bit data pulses                             | 1138        |
| Measuring the density of 32 bit data pulses                             | 1141        |

---

**PART 5 NETWORK INSTRUCTIONS**

---

---

**CHAPTER 29 Ethernet INSTRUCTIONS 1146**

---

|                                                              |             |
|--------------------------------------------------------------|-------------|
| <b>29.1 Open/Close Processing Instructions</b>               | <b>1146</b> |
| Opening a connection                                         | 1146        |
| Closing a connection                                         | 1150        |
| <b>29.2 Socket Communications Instructions</b>               | <b>1152</b> |
| Reading receive data during the END processing               | 1152        |
| Reading receive data when the instruction is executed        | 1157        |
| Sending data                                                 | 1160        |
| Reading connection information                               | 1164        |
| Changing the communication target (UDP/IP)                   | 1167        |
| Changing the receive mode                                    | 1169        |
| Reading socket communications receive data                   | 1174        |
| <b>29.3 Predefined Protocol Support Function Instruction</b> | <b>1176</b> |
| Executing the registered protocols                           | 1176        |
| <b>29.4 SLMP Frame Send Instruction</b>                      | <b>1184</b> |
| Sending an SLMP frame                                        | 1184        |
| Sending an encrypted SLMP frame                              | 1194        |
| <b>29.5 File Transfer Function Instructions</b>              | <b>1203</b> |
| Sending FTP client files                                     | 1203        |
| Retrieving FTP client files                                  | 1209        |

---

**CHAPTER 30 EXTERNAL DEVICE COMMUNICATION INSTRUCTIONS 1215**

---

|                                         |             |
|-----------------------------------------|-------------|
| <b>30.1 Special Adapter Instruction</b> | <b>1215</b> |
| <b>30.2 Serial Communication 2</b>      | <b>1219</b> |

---

**PART 6 STANDARD FUNCTIONS**

---

---

**CHAPTER 31 TYPE CONVERSION FUNCTIONS 1222**

---

|                                      |             |
|--------------------------------------|-------------|
| <b>31.1 Converting BOOL to WORD</b>  | <b>1222</b> |
| <b>31.2 Converting BOOL to DWORD</b> | <b>1223</b> |
| <b>31.3 Converting BOOL to INT</b>   | <b>1224</b> |
| <b>31.4 Converting BOOL to DINT</b>  | <b>1225</b> |
| <b>31.5 Converting BOOL to TIME</b>  | <b>1226</b> |

|       |                                  |      |
|-------|----------------------------------|------|
| 31.6  | Converting BOOL to STRING .....  | 1227 |
| 31.7  | Converting WORD to BOOL .....    | 1228 |
| 31.8  | Converting WORD to DWORD .....   | 1229 |
| 31.9  | Converting WORD to INT .....     | 1230 |
| 31.10 | Converting WORD to DINT .....    | 1231 |
| 31.11 | Converting WORD to TIME .....    | 1232 |
| 31.12 | Converting WORD to STRING .....  | 1233 |
| 31.13 | Converting DWORD to BOOL .....   | 1234 |
| 31.14 | Converting DWORD to WORD .....   | 1235 |
| 31.15 | Converting DWORD to INT .....    | 1237 |
| 31.16 | Converting DWORD to DINT .....   | 1239 |
| 31.17 | Converting DWORD to TIME .....   | 1240 |
| 31.18 | Converting DWORD to STRING ..... | 1241 |
| 31.19 | Converting INT to BOOL .....     | 1242 |
| 31.20 | Converting INT to WORD .....     | 1243 |
| 31.21 | Converting INT to DWORD .....    | 1244 |
| 31.22 | Converting INT to DINT .....     | 1245 |
| 31.23 | Converting INT to BCD .....      | 1246 |
| 31.24 | Converting INT to REAL .....     | 1248 |
| 31.25 | Converting INT to LREAL .....    | 1249 |
| 31.26 | Converting INT to TIME .....     | 1250 |
| 31.27 | Converting INT to STRING .....   | 1251 |
| 31.28 | Converting DINT to BOOL .....    | 1253 |
| 31.29 | Converting DINT to WORD .....    | 1254 |
| 31.30 | Converting DINT to DWORD .....   | 1256 |
| 31.31 | Converting DINT to INT .....     | 1257 |
| 31.32 | Converting DINT to BCD .....     | 1258 |
| 31.33 | Converting DINT to REAL .....    | 1260 |
| 31.34 | Converting DINT to LREAL .....   | 1261 |
| 31.35 | Converting DINT to TIME .....    | 1262 |
| 31.36 | Converting DINT to STRING .....  | 1263 |
| 31.37 | Converting BCD to INT .....      | 1265 |
| 31.38 | Converting BCD to DINT .....     | 1267 |
| 31.39 | Converting BCD to STRING .....   | 1270 |
| 31.40 | Converting REAL to INT .....     | 1272 |
| 31.41 | Converting REAL to DINT .....    | 1274 |
| 31.42 | Converting REAL to LREAL .....   | 1276 |
| 31.43 | Converting REAL to STRING .....  | 1278 |
| 31.44 | Converting LREAL to INT .....    | 1281 |
| 31.45 | Converting LREAL to DINT .....   | 1282 |
| 31.46 | Converting LREAL to REAL .....   | 1283 |
| 31.47 | Converting TIME to BOOL .....    | 1284 |
| 31.48 | Converting TIME to WORD .....    | 1285 |
| 31.49 | Converting TIME to DWORD .....   | 1286 |
| 31.50 | Converting TIME to INT .....     | 1287 |
| 31.51 | Converting TIME to DINT .....    | 1288 |
| 31.52 | Converting TIME to STRING .....  | 1289 |
| 31.53 | Converting STRING to BOOL .....  | 1291 |
| 31.54 | Converting STRING to WORD .....  | 1292 |
| 31.55 | Converting STRING to DWORD ..... | 1293 |
| 31.56 | Converting STRING to INT .....   | 1294 |

|       |                                                   |      |
|-------|---------------------------------------------------|------|
| 31.57 | Converting STRING to DINT .....                   | 1296 |
| 31.58 | Converting STRING to BCD .....                    | 1298 |
| 31.59 | Converting STRING to REAL .....                   | 1300 |
| 31.60 | Converting STRING to TIME .....                   | 1303 |
| 31.61 | Converting Bit Array to INT .....                 | 1304 |
| 31.62 | Converting Bit Array to DINT .....                | 1305 |
| 31.63 | Converting INT to Bit Array .....                 | 1306 |
| 31.64 | Converting DINT to Bit Array .....                | 1307 |
| 31.65 | Copying the Bit Array .....                       | 1308 |
| 31.66 | Reading the Specified Bit of the Word Label ..... | 1309 |
| 31.67 | Writing the Specified Bit of the Word Label ..... | 1311 |
| 31.68 | Copying the Specified Bit of the Word Label ..... | 1313 |
| 31.69 | Getting the Start Data .....                      | 1315 |

---

## CHAPTER 32 SINGLE VARIABLE FUNCTIONS 1316

---

|       |                                         |      |
|-------|-----------------------------------------|------|
| 32.1  | Calculating the Absolute Value .....    | 1316 |
| 32.2  | Calculating the Square Root .....       | 1318 |
| 32.3  | Calculating the Natural Logarithm ..... | 1319 |
| 32.4  | Calculating the Common Logarithm .....  | 1320 |
| 32.5  | Calculating the Exponent .....          | 1322 |
| 32.6  | Calculating the Sine .....              | 1323 |
| 32.7  | Calculating the Cosine .....            | 1324 |
| 32.8  | Calculating the Tangent .....           | 1325 |
| 32.9  | Calculating the Arc Sine .....          | 1326 |
| 32.10 | Calculating the Arc Cosine .....        | 1327 |
| 32.11 | Calculating the Arc Tangent .....       | 1328 |

---

## CHAPTER 33 ARITHMETIC OPERATION FUNCTIONS 1329

---

|      |                                   |      |
|------|-----------------------------------|------|
| 33.1 | Addition .....                    | 1329 |
| 33.2 | Multiplication .....              | 1332 |
| 33.3 | Subtraction .....                 | 1335 |
| 33.4 | Division .....                    | 1338 |
| 33.5 | Remainder .....                   | 1340 |
| 33.6 | Exponentiation .....              | 1342 |
| 33.7 | Assignment (Move Operation) ..... | 1344 |

---

## CHAPTER 34 BIT SHIFT FUNCTIONS 1346

---

|      |                                              |      |
|------|----------------------------------------------|------|
| 34.1 | Shifting Data to the Left by n Bit(s) .....  | 1346 |
| 34.2 | Shifting Data to the Right by n Bit(s) ..... | 1348 |
| 34.3 | Rotating Data to the Left by n Bit(s) .....  | 1350 |
| 34.4 | Rotating Data to the Right by n Bit(s) ..... | 1352 |

---

## CHAPTER 35 BOOLEAN FUNCTIONS 1354

---

|      |                                                      |      |
|------|------------------------------------------------------|------|
| 35.1 | AND Operation, OR Operation, and XOR Operation ..... | 1354 |
| 35.2 | NOT Operation .....                                  | 1357 |

---

## CHAPTER 36 SELECTION FUNCTIONS 1358

---

|      |                                           |      |
|------|-------------------------------------------|------|
| 36.1 | Selecting a Value .....                   | 1358 |
| 36.2 | Selecting the Maximum/Minimum Value ..... | 1360 |
| 36.3 | Controlling the Upper/Lower Limit .....   | 1362 |

|                                                  |                                                              |             |
|--------------------------------------------------|--------------------------------------------------------------|-------------|
| 36.4                                             | Multiplexer .....                                            | 1365        |
| <b>CHAPTER 37 COMPARISON FUNCTIONS</b>           |                                                              | <b>1367</b> |
| 37.1                                             | Comparing Data .....                                         | 1367        |
| 37.2                                             | Comparing Data .....                                         | 1369        |
| <b>CHAPTER 38 STRING FUNCTIONS</b>               |                                                              | <b>1371</b> |
| 38.1                                             | Detecting a String Length .....                              | 1371        |
| 38.2                                             | Extracting String Data From the Left/Right .....             | 1373        |
| 38.3                                             | Extracting String Data .....                                 | 1376        |
| 38.4                                             | Concatenating String Data .....                              | 1378        |
| 38.5                                             | Inserting String Data .....                                  | 1380        |
| 38.6                                             | Deleting String Data .....                                   | 1382        |
| 38.7                                             | Replacing String Data .....                                  | 1384        |
| 38.8                                             | Searching String Data .....                                  | 1387        |
| <b>CHAPTER 39 TIME DATA TYPE FUNCTIONS</b>       |                                                              | <b>1389</b> |
| 39.1                                             | Addition .....                                               | 1389        |
| 39.2                                             | Subtraction .....                                            | 1391        |
| 39.3                                             | Multiplication .....                                         | 1393        |
| 39.4                                             | Division .....                                               | 1395        |
| <br><b>PART 7 STANDARD FUNCTION BLOCKS</b>       |                                                              |             |
| <b>CHAPTER 40 BISTABLE FUNCTION BLOCKS</b>       |                                                              | <b>1398</b> |
| 40.1                                             | Bistable Function Block (Set-dominant) .....                 | 1398        |
| 40.2                                             | Bistable Function Block (Reset-dominant) .....               | 1400        |
| <b>CHAPTER 41 EDGE DETECTION FUNCTION BLOCKS</b> |                                                              | <b>1402</b> |
| 41.1                                             | Detecting a Rising Edge .....                                | 1402        |
| 41.2                                             | Detecting a Falling Edge .....                               | 1404        |
| <b>CHAPTER 42 COUNTER/TIMER FUNCTION BLOCKS</b>  |                                                              | <b>1406</b> |
| 42.1                                             | Up Counter .....                                             | 1406        |
| 42.2                                             | Down Counter .....                                           | 1408        |
| 42.3                                             | Up/Down Counter .....                                        | 1410        |
| 42.4                                             | Counter Function Block .....                                 | 1413        |
| 42.5                                             | Pulse Timer .....                                            | 1415        |
| 42.6                                             | On Delay Timer .....                                         | 1418        |
| 42.7                                             | Off Delay Timer .....                                        | 1420        |
| 42.8                                             | Timer Function Block .....                                   | 1422        |
| <br><b>PART 8 MOTION CONTROL FUNCTION BLOCKS</b> |                                                              |             |
| <b>CHAPTER 43 MOTION CONTROL FB OVERVIEW</b>     |                                                              | <b>1428</b> |
| 43.1                                             | Motion Control FBs .....                                     | 1428        |
|                                                  | How to use Motion control FBs .....                          | 1428        |
|                                                  | Operation of motion control FBs for each system status ..... | 1428        |

|                                                                                            |                 |
|--------------------------------------------------------------------------------------------|-----------------|
| Motion control FB types . . . . .                                                          | 1429            |
| Motion control types . . . . .                                                             | 1436            |
| Error processing . . . . .                                                                 | 1436            |
| Units used in control . . . . .                                                            | 1436            |
| I/O variables used in motion control FBs . . . . .                                         | 1437            |
| Precautions for the motion control FB . . . . .                                            | 1439            |
| <b>43.2 Motion Control FB Configuration . . . . .</b>                                      | <b>1440</b>     |
| Ladder . . . . .                                                                           | 1440            |
| FBD/LD (Function block diagram/ladder) . . . . .                                           | 1441            |
| ST (Structured text) . . . . .                                                             | 1441            |
| <br><b>CHAPTER 44 LIST OF MOTION CONTROL FUNCTION BLOCK VARIABLES</b>                      | <br><b>1442</b> |
| <b>44.1 List of Variables . . . . .</b>                                                    | <b>1442</b>     |
| Axis variables . . . . .                                                                   | 1444            |
| Axes group variables . . . . .                                                             | 1468            |
| System variables . . . . .                                                                 | 1475            |
| Input axis variable . . . . .                                                              | 1479            |
| Output axis variable . . . . .                                                             | 1481            |
| System variable (Advanced synchronous control) . . . . .                                   | 1486            |
| Other structure variables . . . . .                                                        | 1487            |
| Other structure variable (Advanced synchronous control) . . . . .                          | 1507            |
| <b>44.2 List of Enumerators . . . . .</b>                                                  | <b>1520</b>     |
| ENUM enumerators . . . . .                                                                 | 1520            |
| <br><b>CHAPTER 45 ADMINISTRATIVE FUNCTION BLOCKS</b>                                       | <br><b>1528</b> |
| <b>45.1 Axes Group Enabled . . . . .</b>                                                   | <b>1528</b>     |
| <b>45.2 Axes Group Disabled . . . . .</b>                                                  | <b>1532</b>     |
| <b>45.3 Operable . . . . .</b>                                                             | <b>1536</b>     |
| <b>45.4 Current Position Change . . . . .</b>                                              | <b>1540</b>     |
| <b>45.5 Torque Limit Value . . . . .</b>                                                   | <b>1548</b>     |
| <b>45.6 Override Value Setting . . . . .</b>                                               | <b>1556</b>     |
| <b>45.7 Parameter Read . . . . .</b>                                                       | <b>1561</b>     |
| <b>45.8 Parameter Write . . . . .</b>                                                      | <b>1568</b>     |
| <b>45.9 Axis Error Reset . . . . .</b>                                                     | <b>1574</b>     |
| <b>45.10 Axes Group Error Reset . . . . .</b>                                              | <b>1577</b>     |
| <b>45.11 Touch Probe Enabled . . . . .</b>                                                 | <b>1581</b>     |
| <b>45.12 Touch Probe Disabled . . . . .</b>                                                | <b>1596</b>     |
| <b>45.13 Cam Table Selection . . . . .</b>                                                 | <b>1602</b>     |
| <b>45.14 Current Value Change per Cycle . . . . .</b>                                      | <b>1611</b>     |
| <b>45.15 All Axes Operation Available . . . . .</b>                                        | <b>1619</b>     |
| <b>45.16 Axes Group Override Value Setting . . . . .</b>                                   | <b>1622</b>     |
| <b>45.17 Motion Error Reset . . . . .</b>                                                  | <b>1627</b>     |
| <b>45.18 Control Operation Cycle Synchronization . . . . .</b>                             | <b>1631</b>     |
| <b>45.19 Advanced Synchronous Control One Cycle Current Position Calculation . . . . .</b> | <b>1634</b>     |
| <b>45.20 Cam Set Position Calculation in Advanced Synchronous Control . . . . .</b>        | <b>1637</b>     |
| <b>45.21 Digital Cam Switch Output . . . . .</b>                                           | <b>1640</b>     |
| <br><b>CHAPTER 46 MOTION FUNCTION BLOCKS</b>                                               | <br><b>1647</b> |
| <b>46.1 Homing . . . . .</b>                                                               | <b>1647</b>     |
| <b>46.2 Forced Stop . . . . .</b>                                                          | <b>1658</b>     |



|       |                                                     |      |
|-------|-----------------------------------------------------|------|
| 46.3  | Group Forced Stop .....                             | 1663 |
| 46.4  | Absolute Value Positioning .....                    | 1669 |
| 46.5  | Relative Value Positioning .....                    | 1682 |
| 46.6  | JOG Operation.....                                  | 1692 |
| 46.7  | Speed Control .....                                 | 1702 |
| 46.8  | Torque Control.....                                 | 1710 |
| 46.9  | Speed Control (Including Position Loop) .....       | 1721 |
| 46.10 | Absolute Value Linear Interpolation Control .....   | 1730 |
| 46.11 | Relative Value Linear Interpolation Control .....   | 1745 |
| 46.12 | Absolute Value Circular Interpolation Control ..... | 1759 |
| 46.13 | Relative Value Circular Interpolation Control ..... | 1776 |
| 46.14 | Cam Operation Start .....                           | 1795 |
| 46.15 | Gear Operation Start.....                           | 1825 |
| 46.16 | Addition/Subtraction Positioning .....              | 1835 |
| 46.17 | Backlash Compensation Filter.....                   | 1847 |
| 46.18 | Smoothing Filter .....                              | 1861 |
| 46.19 | Moving Direction Restriction Filter .....           | 1871 |
| 46.20 | Speed Limit Filter .....                            | 1880 |
| 46.21 | Axis Control Start Wait .....                       | 1889 |
| 46.22 | Axes Group Control Start Wait.....                  | 1896 |
| 46.23 | Advanced Synchronous Control .....                  | 1903 |
| 46.24 | Multiple Axes Positioning Data Operation .....      | 1909 |
| 46.25 | Absolute Position Tracking Control .....            | 1919 |
| 46.26 | Motion Cyclic Position Control .....                | 1932 |
| 46.27 | Motion Cyclic Velocity Control.....                 | 1941 |
| 46.28 | Motion Cyclic Torque Control .....                  | 1946 |

## **CHAPTER 47 STANDARD FUNCTION BLOCKS** **1953**

|      |                     |      |
|------|---------------------|------|
| 47.1 | Profile Read .....  | 1953 |
| 47.2 | Profile Write ..... | 1969 |

## **PART 9 NETWORK FUNCTION BLOCKS**

### **CHAPTER 48 FUNCTION BLOCKS FOR Ethernet** **1986**

|      |                                          |      |
|------|------------------------------------------|------|
| 48.1 | Opening/Disconnecting a Connection ..... | 1986 |
| 48.2 | Socket Communications.....               | 1992 |
| 48.3 | SLMP.....                                | 1999 |

### **CHAPTER 49 FUNCTION BLOCKS FOR CC-Link IE TSN** **2027**

|      |                   |      |
|------|-------------------|------|
| 49.1 | Remote Reset..... | 2027 |
|------|-------------------|------|

## **APPENDIX** **2033**

|            |                                  |      |
|------------|----------------------------------|------|
| Appendix 1 | Instruction Processing Time..... | 2033 |
|------------|----------------------------------|------|

|                                         |             |
|-----------------------------------------|-------------|
| <b>INDEX</b>                            | <b>2035</b> |
| <b>INSTRUCTION INDEX</b>                | <b>2037</b> |
| REVISIONS .....                         | 2045        |
| CONDITIONS OF USE FOR THE PRODUCT ..... | 2046        |
| WARRANTY .....                          | 2047        |
| INFORMATION AND SERVICES .....          | 2048        |
| TRADEMARKS .....                        | 2048        |

# RELEVANT MANUALS

| Manual name [manual number]                                                        | Description                                                                                                                                                                 |
|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MELSEC MX Controller MX-F Model Programming Manual<br>[SH-082691ENG] (this manual) | Program language specifications, controller instructions, standard functions/function blocks, motion control function blocks, and specifications of network function blocks |
| MELSEC MX Controller MX-F Model User's Manual<br>[SH-082634ENG]                    | Procedures before operation, specifications, devices, memory, functions, parameters, and troubleshooting of the controller                                                  |
| GX Works3 Operating Manual<br>[SH-081215ENG]                                       | System configuration, parameter settings, and online operations of GX Works3                                                                                                |

# TERMS

Unless otherwise specified, this manual uses the following terms.

| Term                                  | Description                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Actual position                       | A position obtained by rounding a position address returned by a device with a ring counter. It is affected by a current position change.                                                                                                                                                                                                                                                    |
| Actual velocity                       | A value obtained by converting the actual value received from the device on the real axis to the unit of the axis                                                                                                                                                                                                                                                                            |
| Axes group variable                   | An AXES_GROUP type variable instance including parameters and data related to the axes group                                                                                                                                                                                                                                                                                                 |
| Axis                                  | A target to perform the motion control                                                                                                                                                                                                                                                                                                                                                       |
| Axis variable                         | An AXIS_* type variable instance including parameters and data related to the axis                                                                                                                                                                                                                                                                                                           |
| Axis warning                          | An error or a warning related to an axis                                                                                                                                                                                                                                                                                                                                                     |
| Basic core                            | A core that executes a program                                                                                                                                                                                                                                                                                                                                                               |
| Buffer memory                         | A memory to store data such as setting values and monitored values. The data include setting values and monitored values of the network function.                                                                                                                                                                                                                                            |
| Buffering                             | Standby status of a motion control FB when multiple start is performed                                                                                                                                                                                                                                                                                                                       |
| Buffering FB                          | A motion control FB that is in a pending status (Busy is TRUE) when multiple start is performed                                                                                                                                                                                                                                                                                              |
| Cam table                             | An operation profile data used for cam control<br>(Ex.) Operation profile data of cam data format or operation profile data of cam data format for rotary cutter                                                                                                                                                                                                                             |
| CC-Link IE TSN Class                  | A group of devices and switching hubs compatible with CC-Link IE TSN, ranked according to the functions and performance by the CC-Link Partner Association.<br>For CC-Link IE TSN Class, refer to the CC-Link IE TSN Installation Manual (BAP-C3007ENG-001) published by the CC-Link Partner Association.                                                                                    |
| CC-Link IE TSN function part          | A part of the controller used for CC-Link IE TSN communications                                                                                                                                                                                                                                                                                                                              |
| CC-Link IE TSN Protocol version 1.0   | This protocol is used to perform communications by using the time sharing method defined by IEEE 802.1AS or IEEE 1588 for time synchronization.                                                                                                                                                                                                                                              |
| CC-Link IE TSN Protocol version 2.0   | This protocol is used to perform communications by using the time sharing method defined by IEEE 802.1AS and time-managed polling method for time synchronization.<br>Supporting this protocol version mitigates restrictions when "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only" is set in the system configuration, and increases the number of connectable devices. |
| Commanded position                    | A command position address that is specified in the motion FB                                                                                                                                                                                                                                                                                                                                |
| Commanded velocity                    | Velocity that is specified in the motion FB                                                                                                                                                                                                                                                                                                                                                  |
| Continuous update                     | Continuous reflection of input values to the control while the ContinuousUpdate input of the motion control FB is TRUE                                                                                                                                                                                                                                                                       |
| Core                                  | An operation circuit of the controller. The controller has multiple cores.                                                                                                                                                                                                                                                                                                                   |
| CPU function part                     | A part of the controller used for sequence control and Ethernet communications                                                                                                                                                                                                                                                                                                               |
| CPU Module Logging Configuration Tool | Software to configure data logging settings and to manage collected data                                                                                                                                                                                                                                                                                                                     |
| Cumulative current position           | A command position address that is not rounded by the ring counter. It is affected by a current position change.                                                                                                                                                                                                                                                                             |
| Cyclic data transfer processing       | Processing of a cyclic transmission from its start to finish, performed by all the stations on a single network. The processing is performed asynchronously with the sequence scan of the controller.<br>The cyclic data transfer processing time varies depending on data volume and the number of transient transmission requests.                                                         |
| Dedicated instruction                 | An instruction that simplifies programming for using functions of intelligent function modules                                                                                                                                                                                                                                                                                               |
| Device                                | A memory of the controller to store data. Devices such as X, Y, M, and D are provided depending on the intended use.                                                                                                                                                                                                                                                                         |
| Device station                        | A station other than a master station: a local station, a remote station                                                                                                                                                                                                                                                                                                                     |
| Disconnection                         | A process of stopping data link for relevant stations if a data link error occurs                                                                                                                                                                                                                                                                                                            |
| Extension core                        | A core to which functions to be executed can be assigned                                                                                                                                                                                                                                                                                                                                     |
| External signal high-accuracy input   | An input signal linked with the signal detection time of the device station                                                                                                                                                                                                                                                                                                                  |
| FB instance                           | A function block that is inserted to a sequence program                                                                                                                                                                                                                                                                                                                                      |
| First point of cam table              | The meaning is different depending on the interpolation method specification for the cam data<br>• Section interpolation or spline interpolation: Point of Table No. 1<br>• Linear interpolation: Point of No. 1                                                                                                                                                                             |
| General-purpose hub                   | A CC-Link IE TSN Class A switching hub authorized by CC-Link Partner Association                                                                                                                                                                                                                                                                                                             |
| Global label                          | A label that is valid for all the program data when multiple program data are created in the project.<br>There are two types of global label: a module specific label (module label), which is generated automatically by GX Works3, and an optional label, which can be created for any specified device.                                                                                   |
| Grandmaster                           | A source device or station to synchronize clocks in the time synchronization via PTP (Precision Time Protocol)                                                                                                                                                                                                                                                                               |
| GX LogViewer                          | Software to display data collected by data logging                                                                                                                                                                                                                                                                                                                                           |

| Term                                    | Description                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GX Works3                               | The product name of the software package for the MELSEC programmable controllers                                                                                                                                                                                                                                                                            |
| Input variable                          | An input argument of FB                                                                                                                                                                                                                                                                                                                                     |
| Intelligent function module             | A module that has functions other than input and output, such as an A/D converter module and D/A converter module                                                                                                                                                                                                                                           |
| iQSS                                    | iQ Sensor Solution. Cooperation of sensors, programmable controllers, HMI (Human Machine Interface), and engineering tool to facilitate the start-up or maintenance of sensors. (iQ Sensor Solution Reference Manual)                                                                                                                                       |
| Jerk                                    | Chronological change rate of acceleration or deceleration                                                                                                                                                                                                                                                                                                   |
| Label                                   | A variable consisting of a specified string used in I/O data or internal processing                                                                                                                                                                                                                                                                         |
| Link device                             | A device (RX, RY, RWr, or RWw) in the CC-Link IE TSN function part or a network module                                                                                                                                                                                                                                                                      |
| Machine feed value                      | A command position address that is not rounded by the ring counter. It is based on the home position, and it is not affected by a current position change.                                                                                                                                                                                                  |
| Master axis (input) absolute coordinate | Another term for the Master axis absolute coordinate (MasterAbsolute) for input variables of MC_CamTableSelect (Cam Table Selection)                                                                                                                                                                                                                        |
| Master station                          | A station that controls the entire network. This station can perform cyclic transmission and transient transmission with all stations. Only one master station can be used in a network.                                                                                                                                                                    |
| Module label                            | A label that represents one of memory areas (I/O signals and buffer memory areas) specific to each module in a given string.<br>For the module used, GX Works3 automatically generates this label, which can be used as a global label.                                                                                                                     |
| Motion control FB                       | An FB that is related to motion control. Its name starts with MC_ or MCv_.                                                                                                                                                                                                                                                                                  |
| Motion FB                               | A motion control FB that takes an axis or an axes group for the argument and changes the axis status or the axes group status when executed                                                                                                                                                                                                                 |
| Motion function part                    | A part of the controller used for motion control                                                                                                                                                                                                                                                                                                            |
| MR Configurator2                        | A product name of the servo setup software                                                                                                                                                                                                                                                                                                                  |
| Multiple axes interpolation control     | Control in which multiple axes work together such as linear interpolation and circular interpolation. Axes to be cooperated are specified in an axes group.                                                                                                                                                                                                 |
| Multiple start                          | Executing another motion control FB to the same axis to which the other motion control FB is being executed                                                                                                                                                                                                                                                 |
| Object                                  | Data of a device compatible with CANopen                                                                                                                                                                                                                                                                                                                    |
| Output variable                         | An output argument of FB                                                                                                                                                                                                                                                                                                                                    |
| POU                                     | A unit that configures a program. Units are categorized and provided in accordance with functions. A program that is composed of POUs (program organization units) allows the lower-layer processing, when the program is multi-layered, to be divided into several units by processing and function, enabling the creation of programs based on each unit. |
| Predefined protocol support function    | A function of GX Works3. This function sets protocols appropriate to each external device and reads/writes protocol setting data.                                                                                                                                                                                                                           |
| Program block                           | A group of POUs that configure a program                                                                                                                                                                                                                                                                                                                    |
| Real axis                               | An axis that is linked with a device on the network                                                                                                                                                                                                                                                                                                         |
| Real drive axis                         | An axis that is linked with a CC-Link IE TSN compatible device that supports csp/csv/cst mode (sequential command) of the CiA402 drive profile                                                                                                                                                                                                              |
| Real encoder axis                       | An axis that generates a commanded position from the current position of the encoder connected with a device. It is used for the master axis of the single axis synchronous control.                                                                                                                                                                        |
| Reconnection                            | A process of restarting data link for relevant stations when the faulty station recovers from an error                                                                                                                                                                                                                                                      |
| Relay station                           | A station that relays data link to other station with mounting more than one network modules on one programmable controller.                                                                                                                                                                                                                                |
| Remote station                          | A station that exchanges I/O signals (bit data) and I/O data (word data) with another station by cyclic transmission. This station can perform transient transmission.                                                                                                                                                                                      |
| Reserved address                        | An IP address reserved for special purposes, defined by RFC 6890. This IP address cannot be used when the programmable controller is connected via the global IP network.                                                                                                                                                                                   |
| Routing                                 | A process of selecting paths for communication with other networks. There are two types of routing: dynamic routing that auto-selects the communication routes, and static routing where communication routes are arbitrarily set.                                                                                                                          |
| RWr                                     | A remote register of the link device. Word data (16-bit data) input from a device station to the master station.                                                                                                                                                                                                                                            |
| RWw                                     | A remote register of the link device. Word data (16-bit data) output from the master station to a device station.                                                                                                                                                                                                                                           |
| RX                                      | Remote input of the link device. Bit data input from a device station to the master station.                                                                                                                                                                                                                                                                |
| RY                                      | Remote output of the link device. Bit data output from the master station to a device station.                                                                                                                                                                                                                                                              |
| SB                                      | An abbreviation for a link special relay. Bit data that indicates the operating status and data link status of a module on CC-Link IE.                                                                                                                                                                                                                      |
| Set position                            | A commanded position address rounded by the ring counter. It is affected by a current position change.                                                                                                                                                                                                                                                      |
| Set velocity                            | The current control value that is generated by motion operation                                                                                                                                                                                                                                                                                             |

| Term                                    | Description                                                                                                                                                                                                                                                  |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signal flow                             | The execution status that the last time an operation of a program or an FB is executed in each step.                                                                                                                                                         |
| Single axis synchronization             | A control to output the position information (command) of one Slave (slave axis) that is synchronized with Master (master axis)                                                                                                                              |
| Slave axis (output) absolute coordinate | Another term for the Slave axis absolute coordinate (SlaveAbsolute) for input variables of MC_CamTableSelect (Cam Table Selection)                                                                                                                           |
| SLMP                                    | A SeamLess Message Protocol.<br>This protocol is used to access an SLMP-compatible device or a programmable controller connected to an SLMP-compatible device from an external device.                                                                       |
| SW                                      | An abbreviation for a link special register. Word data that indicates the operating status and data link status of a module on CC-Link IE.                                                                                                                   |
| Switching speed                         | <ul style="list-style-type: none"> <li>• The set velocity of the on-going motion control FB when Aborting is specified</li> <li>• The command velocity when the on-going motion control FB reached the target position when Blending is specified</li> </ul> |
| System error                            | An error or a warning not related to an axis. When Axis information (Axis) and Axes Group Information (AxesGroup) of the motion control FBs are not correct, the system error will occur.                                                                    |
| Target position                         | A command position address that is specified in the motion FB                                                                                                                                                                                                |
| Transient transmission group number     | Number that is assigned for transient transmission to any given stations. By specifying a group of stations as transient transmission target, data can be sent to the stations of the same group No.                                                         |
| TSN hub                                 | A CC-Link IE TSN Class B switching hub authorized by CC-Link Partner Association                                                                                                                                                                             |
| Unicast mode                            | A communication mode used to send cyclic data to one station                                                                                                                                                                                                 |
| Virtual axis                            | An axis that is not linked with a device on network                                                                                                                                                                                                          |
| Virtual drive axis                      | A virtual axis that can generate a command virtually                                                                                                                                                                                                         |
| Virtual encoder axis                    | An axis that generates a commanded position from a variable. It is used as the master axis of the single axis synchronous control.                                                                                                                           |
| Virtual linked axis                     | An axis that connects FBs and transmits commands in the single axis synchronous control                                                                                                                                                                      |

# GENERIC TERMS AND ABBREVIATIONS

Unless otherwise specified, this manual uses the following generic terms and abbreviations.

| Generic term and abbreviation | Description                                                                                                                                                                                                                                                                                       |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CC-Link IE                    | A generic term for the following items: <ul style="list-style-type: none"> <li>• CC-Link IE TSN</li> <li>• CC-Link IE Controller Network</li> <li>• CC-Link IE Field Network</li> </ul>                                                                                                           |
| Controller                    | A generic term for the MXF100-8-N32, MXF100-8-P32, MXF100-16-N32, and MXF100-16-P32                                                                                                                                                                                                               |
| csp                           | An abbreviation for cyclic synchronous position mode (one of the control modes on the drive unit side)                                                                                                                                                                                            |
| cst                           | An abbreviation for cyclic synchronous torque mode (one of the control modes on the drive unit side)                                                                                                                                                                                              |
| csv                           | An abbreviation for cyclic synchronous velocity mode (one of the control modes on the drive unit side)                                                                                                                                                                                            |
| ct                            | An abbreviation for continuous operation to torque control mode (one of the control modes on the drive unit side)                                                                                                                                                                                 |
| Data link                     | A generic term for cyclic transmission and transient transmission                                                                                                                                                                                                                                 |
| Device supporting iQSS        | A device which supports iQ Sensor Solution.<br> iQ Sensor Solution Reference Manual                                                                                                                              |
| Drive unit                    | A generic term for motor drive devices such as a servo amplifier                                                                                                                                                                                                                                  |
| Engineering tool              | A tool used for setting up controllers or servo amplifiers, programming, debugging, and maintenance                                                                                                                                                                                               |
| Ethernet device               | A generic term for the devices supporting IP communication (such as a personal computer, a vision sensor, and a bar code reader)                                                                                                                                                                  |
| Ethernet-equipped module      | A generic term for the following modules: <ul style="list-style-type: none"> <li>• Controller (when the Ethernet function is used)</li> </ul>                                                                                                                                                     |
| GOT                           | A generic term for Mitsubishi Electric Graphic Operation Terminal GOT1000 and GOT2000 series                                                                                                                                                                                                      |
| hm                            | An abbreviation for homing mode (one of the control modes on the drive unit side)                                                                                                                                                                                                                 |
| I/O module                    | An input module, an output module, and an I/O module                                                                                                                                                                                                                                              |
| ICMP                          | An abbreviation for Internet Control Message Protocol. This protocol is used to exchange messages of errors in an IP network or other information related to an Ethernet network.                                                                                                                 |
| MCFB                          | An abbreviation for motion control FB                                                                                                                                                                                                                                                             |
| MR-J5(W)-G                    | A generic term for the MR-J5-_G/MR-J5-_G_-RJ/MR-J5-_G_-LL/MR-J5W-_G/MR-J5D-_G_ model servo amplifiers                                                                                                                                                                                             |
| Operation profile data        | A generic term for waveform data used for each control                                                                                                                                                                                                                                            |
| PDO                           | An abbreviation for Process Data Object. Aggregation of application objects transferred periodically between multiple CANopen nodes.                                                                                                                                                              |
| PTP                           | An abbreviation for Precision Time Protocol. A predefined protocol for time synchronization between devices on a network.                                                                                                                                                                         |
| SDO                           | An abbreviation for Service Data Object. A message to access an object entry in the object dictionary of a CANopen node. Data is sent/received between the stations aperiodically.                                                                                                                |
| SLMP                          | An abbreviation for Seamless Message Protocol. This protocol is used to access an SLMP-compatible device from an external device (such as a personal computer or HMI (Human Machine Interface)) or an SLMP-compatible module (such as the Ethernet-equipped module or modules on CC-Link IE TSN). |
| Station sub ID number         | An ID number of a sensor connected to a CC-Link-compatible communication module                                                                                                                                                                                                                   |

# MEMO

---



This part consists of the following chapters.

1 OVERVIEW

---

2 PROGRAM ORGANIZATION UNITS

---

3 LADDER DIAGRAM

---

4 STRUCTURED TEXT LANGUAGE

---

5 FBD/LD

---

# 1 OVERVIEW

## 1.1 Instruction Configuration

Many instructions available for controllers are each divided into the instruction part and operand part.

The instruction part and operand part are used as follows.

- Instruction part: Indicates the function of the relevant instruction.
- Operand part: Indicates the data used for the instruction.

The operand part is further classified to source data, destination data, and numerical data.

### Source (s)

Source is the data used in the operation.

Depending on the label or device specified in each instruction, the source becomes as follows.

| Type            | Description                                                                                                                                                                                                                                                                                                                                            |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Constant        | The constant specifies a numerical value used in the operation.<br>It is set during program creation and cannot be changed during program execution.<br>When using constants in variable data, perform index modification.*1                                                                                                                           |
| Device<br>Label | The user specifies the device or label where the data to be used in the operation is stored.<br>Necessary data must be thus stored in the specified device or label before operation execution.<br>By changing the data to be stored in the specified device or label during program execution, the data to be used by the instruction can be changed. |

\*1 For the index modification, refer to the following.

 User's manual for the controller used

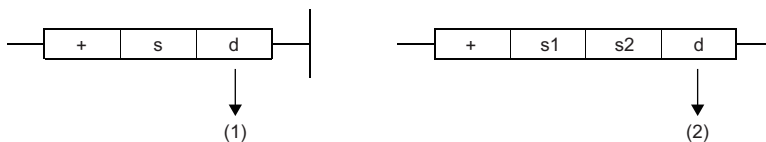
### Destination (d)

Data after operation is stored in the destination area.

However, some instructions require the data to be used in the operation to be stored before the operation.

**Ex.**

Binary 16-bit data addition instruction



(1) The data required for operation is stored before the operation.

(2) Only the operation result is stored.

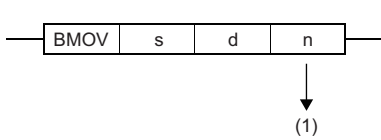
A label or device to store data must be set for the destination.

## Numerical value (n)

For the numerical values of the numbers of devices, transfers, data, and character strings, specify those used by an instruction which uses multiple devices or an instruction which specifies the numbers of repetitions, data to be processed, and character strings.

**Ex.**

Block transfer instruction



(1) The number of transfers executed by the BMOV instruction is specified.

A numerical value from 0 to 65535 or 0 to 4294967295 can be set for the size such as the number of devices, transfers, or characters. <sup>\*1</sup>

Note, however, that when the size specification such as the number of devices, transfers, or characters is 0, the relevant instruction results in non-processing.

The upper limit of the numerical value may be less than the values mentioned above, depending on the capacity of the device memory or file storage area. <sup>\*2</sup>

<sup>\*1</sup> The setting range varies depending on the instruction. For details, refer to the description of each instruction.

<sup>\*2</sup> The capacities of the device memory and file storage area vary depending on models. For details, refer to the following.

User's manual for the controller used

### Point

Be careful when a large numerical value is used such as for the number of transfers. It delays the scan time.

# 1.2 Data Specification Method

The following table lists the types of data that can be used for instructions in controllers.

| Data                                   | Classification                    |
|----------------------------------------|-----------------------------------|
| Bit data                               | Bit data                          |
| 16-bit data (word data)                | 16-bit signed binary data         |
|                                        | 16-bit unsigned binary data       |
| 32-bit data (double word data)         | 32-bit signed binary data         |
|                                        | 32-bit unsigned binary data       |
| Real number data (floating-point data) | Single-precision real number data |
|                                        | Double-precision real number data |
| BCD data                               | BCD 4-digit data                  |
|                                        | BCD 8-digit data                  |
|                                        | BCD 16-digit data                 |
| String data                            | String                            |
|                                        | Unicode string                    |

## Device data

The following table lists devices and constants that can be used to specify the setting data of instructions.

| Data type                    | Description                                                                                                                                              | Specifiable device/constant <sup>*1</sup>                                                                                                                                                                               |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bit                          | Bit data can be handled.<br>☞ Page 33 Bit data                                                                                                           | <ul style="list-style-type: none"> <li>• Bit device</li> <li>• Bit specification of word device</li> </ul>                                                                                                              |
| Word                         | Word data can be handled.<br>☞ Page 34 16-bit data (word data)                                                                                           | <ul style="list-style-type: none"> <li>• Word device</li> <li>• Digit-specified bit device (K1 to K4)<sup>*2</sup></li> </ul>                                                                                           |
| 16-bit signed binary         | 16-bit data can be handled.                                                                                                                              | <ul style="list-style-type: none"> <li>• Decimal constant</li> <li>• Hexadecimal constant</li> </ul>                                                                                                                    |
| 16-bit unsigned binary       | The value range varies depending on whether the value is signed or unsigned.<br>☞ Page 34 16-bit data (word data)                                        |                                                                                                                                                                                                                         |
| Double word                  | Double-word data can be handled.<br>☞ Page 36 32-bit data (double word data)                                                                             | <ul style="list-style-type: none"> <li>• Word device</li> <li>• Double-word device</li> <li>• Digit-specified bit device (K1 to K8)<sup>*2</sup></li> <li>• Decimal constant</li> <li>• Hexadecimal constant</li> </ul> |
| 32-bit signed binary         | Two consecutive sets of 32-bit data or 16-bit data can be handled.                                                                                       |                                                                                                                                                                                                                         |
| 32-bit unsigned binary       | The value range varies depending on whether the value is signed or unsigned.<br>☞ Page 36 32-bit data (double word data)                                 |                                                                                                                                                                                                                         |
| BCD 4-digit                  | BCD 4-digit data can be handled.<br>16-bit data is divided by 4 digits and each digit is specified in 0 to 9.                                            | <ul style="list-style-type: none"> <li>• Word device</li> <li>• Digit-specified bit device (K1 to K4)<sup>*2</sup></li> <li>• Decimal constant</li> <li>• Hexadecimal constant</li> </ul>                               |
| BCD 8-digit                  | BCD 8-digit data can be handled.<br>32-bit data is divided by 8 digits and each digit is specified in 0 to 9.                                            | <ul style="list-style-type: none"> <li>• Word device</li> <li>• Double-word device</li> <li>• Digit-specified bit device (K1 to K8)<sup>*2</sup></li> <li>• Decimal constant</li> <li>• Hexadecimal constant</li> </ul> |
| Single-precision real number | Single-precision real number data (single-precision floating-point data) can be handled.<br>☞ Page 39 Configuration of single-precision real number data | <ul style="list-style-type: none"> <li>• Word device</li> <li>• Double-word device</li> <li>• Real constant</li> </ul>                                                                                                  |
| Double-precision real number | Double-precision real number data (double-precision floating-point data) can be handled.<br>☞ Page 40 Configuration of double-precision real number data | <ul style="list-style-type: none"> <li>• Word device</li> <li>• Double-word device</li> <li>• Real constant</li> </ul>                                                                                                  |
| Character string             | ASCII code and Shift JIS code character string data can be handled.<br>☞ Page 42 String data                                                             | <ul style="list-style-type: none"> <li>• Word device</li> <li>• Character string constant</li> </ul>                                                                                                                    |
| Unicode character string     | Unicode character string data can be handled.<br>☞ Page 42 String data                                                                                   | <ul style="list-style-type: none"> <li>• Word device</li> <li>• Character string constant</li> </ul>                                                                                                                    |
| Device name                  | A device can be specified directly.                                                                                                                      | <ul style="list-style-type: none"> <li>• Device name corresponding to applicable device</li> </ul>                                                                                                                      |

\*1 A constant can be used in the data specified for the source (s) or numerical data (n) by an instruction.

\*2 For the specification method, refer to the detail page of each data type.

## Label data

The following table lists labels that can be used to specify the setting data of instructions.

### ■ Primitive data type

| Data type (label)                                      | Specifiable label                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bit<br>(BOOL)                                          | <ul style="list-style-type: none"> <li>• Bit type label</li> <li>• Bit-specified word [unsigned]/bit string [16 bits] type label</li> <li>• Bit-specified word [signed] type label</li> <li>• Timer/retentive timer/long timer/long retentive timer type label contact/coil</li> <li>• Counter/ long counter type label contact/coil</li> </ul> |
| Word [unsigned]/bit string [16 bits]<br>(WORD)         | <ul style="list-style-type: none"> <li>• Word [unsigned]/bit string [16 bits] type label</li> <li>• Digit-specified bit type label (K1 to K4)</li> <li>• Current value of timer/retentive timer type label</li> <li>• Current value of counter type label</li> </ul>                                                                            |
| Double word [unsigned]/bit string [32 bits]<br>(DWORD) | <ul style="list-style-type: none"> <li>• Double word [unsigned]/bit string [32 bits] type label</li> <li>• Digit-specified bit type label (K1 to K8)</li> <li>• Current value of long timer/long retentive timer type label</li> <li>• Current value of long counter type label</li> </ul>                                                      |
| Word [signed]<br>(INT)                                 | <ul style="list-style-type: none"> <li>• Word [signed] type label</li> <li>• Digit-specified bit type label (K1 to K4)</li> <li>• Current value of timer/retentive timer type label</li> <li>• Current value of counter type label</li> </ul>                                                                                                   |
| Double word [signed]<br>(DINT)                         | <ul style="list-style-type: none"> <li>• Double word [signed] type label</li> <li>• Digit-specified bit type label (K1 to K8)</li> <li>• Current value of long timer/long retentive timer type label</li> <li>• Current value of long counter type label</li> </ul>                                                                             |
| Single-precision real number<br>(REAL)                 | <ul style="list-style-type: none"> <li>• Single-precision real data type label</li> </ul>                                                                                                                                                                                                                                                       |
| Double-precision real number<br>(LREAL)                | <ul style="list-style-type: none"> <li>• Double-precision real data type label</li> </ul>                                                                                                                                                                                                                                                       |
| Time<br>(TIME)                                         | <ul style="list-style-type: none"> <li>• Time type label</li> </ul>                                                                                                                                                                                                                                                                             |
| Character string<br>(STRING)                           | <ul style="list-style-type: none"> <li>• Character string type label</li> </ul>                                                                                                                                                                                                                                                                 |
| Character string [Unicode]<br>(WSTRING)                | <ul style="list-style-type: none"> <li>• Character string [Unicode] type label</li> </ul>                                                                                                                                                                                                                                                       |
| Pointer<br>(POINTER)                                   | <ul style="list-style-type: none"> <li>• Pointer type label</li> </ul>                                                                                                                                                                                                                                                                          |



For details on individual labels, refer to the following.

User's manual for the controller used

## ■Generic data type

The generic data type is the data type of the labels which summarize several primitive data types.

Generic data types are used when multiple data types are allowed for arguments and return values of functions or function blocks.

Labels defined in generic data types can be used in any sub-level data type.

| Data type (label) |                |              |                          |            |            | Specifiable data type        |                                             |                                                     |            |
|-------------------|----------------|--------------|--------------------------|------------|------------|------------------------------|---------------------------------------------|-----------------------------------------------------|------------|
| ANY* <sup>1</sup> | ANY_ELEMENTARY | ANY_BIT      |                          |            |            | ANY_BOOL                     | Bit                                         |                                                     |            |
|                   |                |              |                          |            |            | ANY_BITADDR* <sup>1</sup>    | Bit                                         |                                                     |            |
|                   |                |              |                          |            |            | ANY16_U                      | Word [unsigned]/bit string [16 bits]        |                                                     |            |
|                   |                |              |                          |            |            | ANY32_U                      | Double word [unsigned]/bit string [32 bits] |                                                     |            |
|                   |                | ANY_WORDADDR | ANY_NUM                  | ANY_INT    | ANY16      | ANY16_S                      | Word [signed]                               |                                                     |            |
|                   |                |              |                          |            |            | ANY16_U                      | Word [unsigned]/bit string [16 bits]        |                                                     |            |
|                   |                |              |                          |            | ANY32      | ANY32_S                      | Double word [signed], time                  |                                                     |            |
|                   |                |              |                          |            |            | ANY32_U                      | Double word [unsigned]/bit string [32 bits] |                                                     |            |
|                   |                |              |                          | ANY_REAL   | ANYREAL_32 | Single-precision real number |                                             |                                                     |            |
|                   |                |              |                          |            | ANYREAL_64 | Double-precision real number |                                             |                                                     |            |
|                   |                |              |                          | ANY_STRING |            |                              | ANYSTRING_SINGLE                            | String                                              |            |
|                   |                |              |                          |            |            |                              | ANYSTRING_DOUBLE                            | Character string [Unicode]                          |            |
|                   |                |              | ANY16_OR_STRING_SINGLE   |            |            | ANY16_S                      | Word [signed]                               |                                                     |            |
|                   |                |              |                          |            |            | ANY16_U                      | Word [unsigned]/bit string [16 bits]        |                                                     |            |
|                   |                |              |                          |            |            | ANYSTRING_SINGLE             | String                                      |                                                     |            |
|                   |                |              | ANY_DT                   |            |            |                              |                                             | Word [signed], word [unsigned]/bit string [16 bits] |            |
|                   |                |              | ANY_TM                   |            |            |                              |                                             | Word [signed], word [unsigned]/bit string [16 bits] |            |
|                   |                |              | ANY_STRUCT* <sup>1</sup> |            |            |                              |                                             |                                                     | Structures |
|                   |                |              | STRUCT                   |            |            |                              |                                             |                                                     | Structures |

\*1 Can also be used as an array.

## ■Generic data type (array)

For the following generic data type, define the number of array elements.

| Data type (label) |                  |                         | Specifiable data type                             |
|-------------------|------------------|-------------------------|---------------------------------------------------|
| ANYBIT_ARRAY      |                  |                         | Bit array                                         |
| ANYWORD_ARRAY     | ANY16_ARRAY      | ANY16_S_ARRAY           | Word [signed] array                               |
|                   |                  | ANY16_U_ARRAY           | Word [unsigned]/bit string [16 bits] array        |
|                   | ANY32_ARRAY      | ANY32_S_ARRAY           | Double word [signed] array, time array            |
|                   |                  | ANY32_U_ARRAY           | Double word [unsigned]/bit string [32 bits] array |
|                   | ANY_REAL_ARRAY   | ANY_REAL_32_ARRAY       | Single-precision real number array                |
|                   |                  | ANY_REAL_64_ARRAY       | Double-precision real number array                |
|                   | ANY_STRING_ARRAY | ANY_STRING_SINGLE_ARRAY | Character string array                            |
|                   |                  | ANY_STRING_DOUBLE_ARRAY | Character string [Unicode] array                  |
| STRUCT_ARRAY      |                  |                         | Structure array                                   |

# Bit data

## Data size and data range

Bit data is handled in increments of bits such as contacts and coils.

| Data name | Data size | Value range |
|-----------|-----------|-------------|
| Bit data  | 1 bit     | 0, 1        |

## Handling bit data with bit devices and labels

One point of bit device/label can handle 1-bit data.

## Handling bit data with bit word devices

By specifying a bit number for a word device, bit data of the specified bit number can be handled.

A bit in a word device can be specified by "Word device number.Bit number".

A bit number can be specified in hexadecimal in the range from 0 to F.

For example, bit 5 (b5) of D0 is specified as D0.5, and bit 10 (b10) of D0 is specified as D0.A.

The following word devices support bit specification.

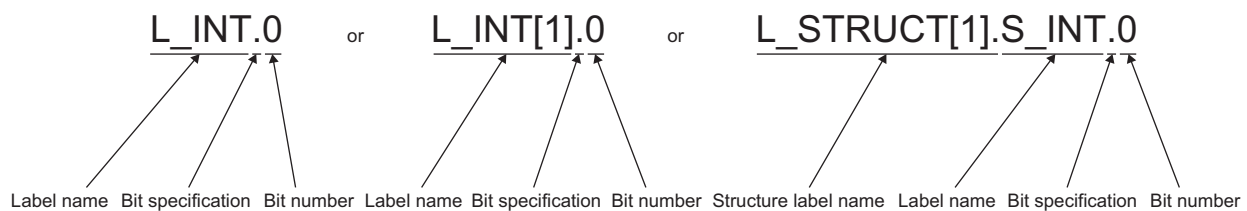
| Item                                         | Device                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Word devices which support bit specification | <ul style="list-style-type: none"> <li>• Data register (D)</li> <li>• Link register (W, J□\W)</li> <li>• Link special register (SW, J□\SW)</li> <li>• Function register (FD)</li> <li>• Special register (SD)</li> <li>• Module access device (U□\G)</li> <li>• CPU Buffer memory access device (U3E□\G)</li> <li>• File register (R, ZR)</li> <li>• Module refresh register (RD)</li> </ul> |

## Handling bit data with word type labels

By specifying a bit number for a word type label, bit data of the specified bit number can be handled.

A bit in a word type label can be specified by "Label name.Bit number".

**Ex.**



The following data types of labels support bit specification.

| Item                                                  | Data type                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data types of labels which support bit specification. | <ul style="list-style-type: none"> <li>• Word [signed] (INT type)</li> <li>• Word [unsigned]/bit string [16 bits] (WORD type)</li> <li>• Current value (N) of timer (TIMER type)*1</li> <li>• Current value (N) of retentive timer (RETENTIVETIMER type)*1</li> <li>• Current value (N) of counter (COUNTER type)*1</li> </ul> |

\*1 Cannot be specified in ladder programs.

## 16-bit data (word data)

### Data size and data range

16-bit data includes signed and unsigned 16-bit data.

In signed 16-bit data, a negative number is represented in two's complement.

| Data name            | Data size        | Value range      |                      |
|----------------------|------------------|------------------|----------------------|
|                      |                  | Decimal notation | Hexadecimal notation |
| Signed 16-bit data   | 16 bits (1 word) | -32768 to 32767  | 0000H to FFFFH       |
| Unsigned 16-bit data |                  | 0 to 65535       |                      |

### Handling 16-bit data with bit devices

A bit device can be handled as 16-bit data by performing digit specification.

| Item       |                               | Notation                                                                                                                                              | Example             |
|------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Bit device | Other than link direct device | K□Bit device start number<br>□: Number of digits (Specify the number within the range of 1 to 4.)                                                     | K4X40<br>K2M113     |
|            | Link direct device            | J□K□Bit device start number<br>□ (on the left): Network number<br>□ (on the right): Number of digits (Specify the number within the range of 1 to 4.) | J1K3B10<br>J10K2Y40 |

### Handling 16-bit data with bit type array labels

A bit type array label can be handled as 16-bit data by performing digit specification.

The following table shows the notation for handling a bit type array label as 16-bit data by digit specification.

| Item                 | Notation                                                                                                                               | Example  |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------|
| Bit type array label | K□Label name<br>□: Number of digits (Specify the number within the range of 1 to 4.)<br>Specify a label name without an array element. | K1L_BOOL |



## Digit specification range

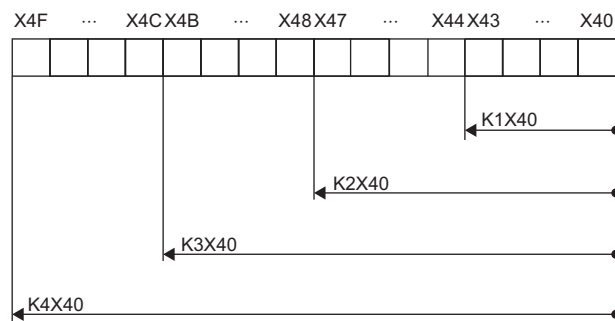
The following table lists the range of 16-bit data for each digit specification.

| Digit specification | Decimal notation                                                        | Hexadecimal notation |
|---------------------|-------------------------------------------------------------------------|----------------------|
| K1                  | 0 to 15                                                                 | 0H to FH             |
| K2                  | 0 to 255                                                                | 00H to FFH           |
| K3                  | 0 to 4095                                                               | 000H to FFFH         |
| K4                  | Signed 16-bit data: -32768 to 32767<br>Unsigned 16-bit data: 0 to 65535 | 0000H to FFFFH       |

### Ex.

When digit specification is made for X40, the applicable number of points is as follows.

- K1X40→4 points from X40 to X43
- K2X40→8 points from X40 to X47
- K3X40→12 points from X40 to X4B
- K4X40→16 points from X40 to X4F



## Specifying a bit device with digit specification in the source (s)

When a bit device is specified with digit specification in the source of an instruction, 0 is stored in the word device of the destination, in the upper bits than those specified in the source of the instruction.

| Ladder example                   | Processing |
|----------------------------------|------------|
| <p>• 16-bit data instruction</p> |            |

## Specifying a bit device with digit specification in the destination (d)

When a digit specification is made in the destination of an instruction, the number of points by the digit specification is applicable in the destination.

The upper bit devices than the number of points specified by digits remain unchanged.

| Ladder example                                 | Processing                           |
|------------------------------------------------|--------------------------------------|
| <p>• When the source data is a word device</p> | <p>(1) The data remain the same.</p> |

## Handling 16-bit data with word devices/labels

### ■Word device

One point of word device can handle 16-bit data.

### ■Word type label

One point of word type label can handle 16-bit data.

## 32-bit data (double word data)

### Data size and data range

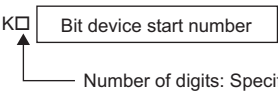
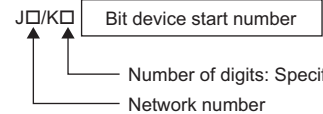
32-bit data includes signed and unsigned 32-bit data.

In signed 32-bit data, a negative number is represented in two's complement.

| Data name            | Data size        | Value range               |                        |
|----------------------|------------------|---------------------------|------------------------|
|                      |                  | Decimal notation          | Hexadecimal notation   |
| Signed 32-bit data   | 32 bits (2 word) | -2147483648 to 2147483647 | 00000000H to FFFFFFFFH |
| Unsigned 32-bit data |                  | 0 to 4294967295           |                        |

### Handling 32-bit data with bit devices

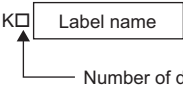
A bit device can be handled as 32-bit data by performing digit specification.

| Item       |                               | Notation                                                                            | Example              |
|------------|-------------------------------|-------------------------------------------------------------------------------------|----------------------|
| Bit device | Other than link direct device |   | K8X80<br>K6B018      |
|            | Link direct device            |  | J1K7B30<br>J10K5X128 |

### Handling 32-bit data with bit type array labels

A bit type array label can be handled as 32-bit data by performing digit specification.

The following table shows the notation for handling a bit type array label as 32-bit data by digit specification.

| Item                 | Notation                                                                                                                                                                                                                                                                                                                                                  | Example  |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Bit type array label | <br><br>Specify a label name without an array element.<br>For languages other than ladder, specify the number within the range of K5 to K8.<br>(For languages other than ladder, the label with digit specification within the range of K1 to K4 is handled as ANY16.) | K8L_BOOL |

## Digit specification range

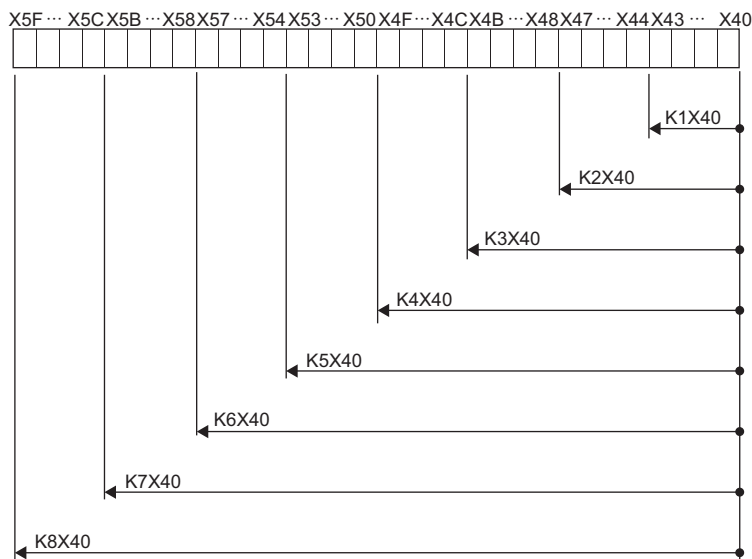
The following table lists the range of 32-bit data for each digit specification.

| Digit specification | Decimal notation                                                                       | Hexadecimal notation   |
|---------------------|----------------------------------------------------------------------------------------|------------------------|
| K1                  | 0 to 15                                                                                | 0H to FH               |
| K2                  | 0 to 255                                                                               | 00H to FFH             |
| K3                  | 0 to 4095                                                                              | 000H to FFFH           |
| K4                  | 0 to 65535                                                                             | 0000H to FFFFH         |
| K5                  | 0 to 1048575                                                                           | 00000H to FFFFFH       |
| K6                  | 0 to 16777215                                                                          | 000000H to FFFFFFFH    |
| K7                  | 0 to 268435455                                                                         | 0000000H to FFFFFFFFH  |
| K8                  | Signed 32-bit data: -2147483648 to 2147483647<br>Unsigned 32-bit data: 0 to 4294967295 | 00000000H to FFFFFFFFH |

### Ex.

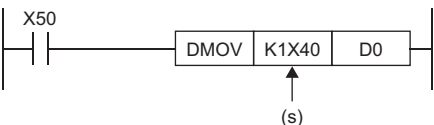
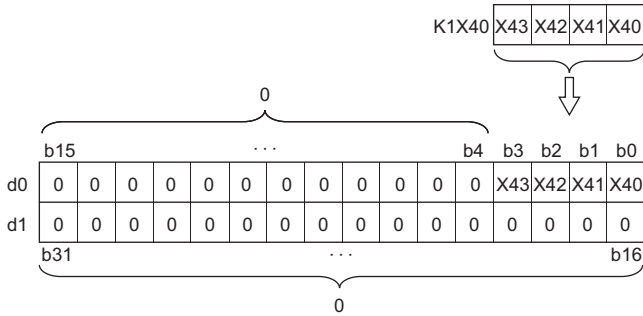
When digit specification is made for X40, the applicable number of points is as follows.

- K1X40→4 points from X40 to X43
- K2X40→8 points from X40 to X47
- K3X40→12 points from X40 to X4B
- K4X40→16 points from X40 to X4F
- K5X40→20 points from X40 to X53
- K6X40→24 points from X40 to X57
- K7X40→28 points from X40 to X5B
- K8X40→32 points from X40 to X5F



## ■Specifying a bit device with digit specification in the source (s)

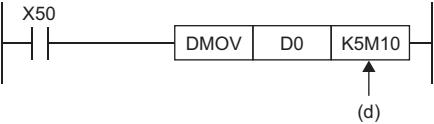
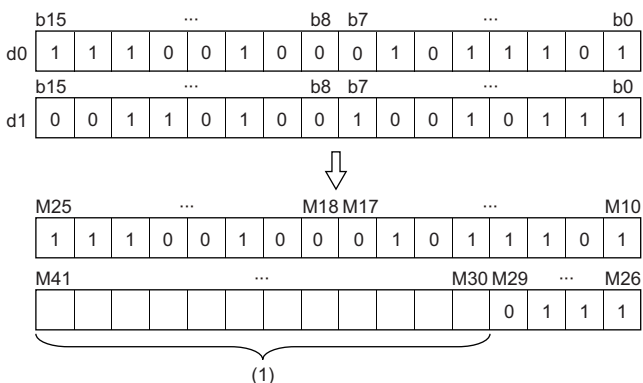
When a bit device is specified with digit specification in the source of an instruction, 0 is stored in the word device of the destination, in the upper bits than those specified in the source of the instruction.

| Ladder example                                                                                                                                              | Processing                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>32-bit data instruction</li> </ul>  |  |

## ■Specifying a bit device with digit specification in the destination (d)

When a digit specification is made in the destination of an instruction, the number of points by the digit specification is applicable in the destination.

The upper bit devices than the number of points specified by digits remain unchanged.

| Ladder example                                                                                                                                                             | Processing                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>When the source data is a word device</li> </ul>  |  <p>(1) The data remain the same.</p> |

## Handling 32-bit data with word devices/labels

### ■Word device

Two points of word device can handle 32-bit data.

Note, however, that one point of the following devices can handle 32-bit data.

- Long timer (LT)
- Long retentive timer (LST)
- Long counter (LC)
- Long index register (LZ)

### ■Double word type label

One point of double word device can handle 32-bit data.

# Real number data (floating-point data)

## Data size and data range

Real number data includes single-precision 32-bit real number data and double-precision 64-bit real number data.

Real number data can be stored only in devices other than bit devices or in single-precision or double-precision real data type labels.

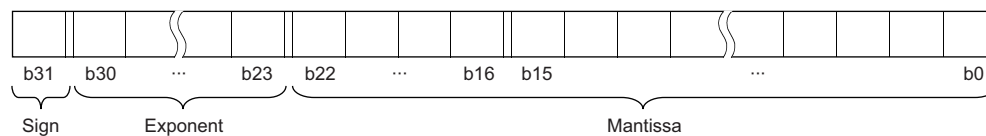
| Data name                                                                |                 | Data size        | Value range                                      |
|--------------------------------------------------------------------------|-----------------|------------------|--------------------------------------------------|
| Single-precision real number data (single-precision floating-point data) | Positive number | 32 bits (2 word) | $2^{-126} \leq \text{real number} < 2^{126}$     |
|                                                                          | Zero            |                  | 0                                                |
|                                                                          | Negative number |                  | $-2^{126} < \text{real number} \leq -2^{-126}$   |
| Double-precision real number data (double-precision floating-point data) | Positive number | 64 bits (4 word) | $2^{-1022} \leq \text{real number} < 2^{1024}$   |
|                                                                          | Zero            |                  | 0                                                |
|                                                                          | Negative number |                  | $-2^{1024} < \text{real number} \leq -2^{-1022}$ |

## Configuration of single-precision real number data

Single-precision real number data consists of a sign, mantissa, and exponent, and is expressed as shown below.



The following figure shows the bit configuration of the internal expression of single-precision real number data and the meaning of each part.



### ■Sign (1 bit)

This bit represents the positive or negative sign of a numerical value. "0" indicates a positive number or 0. "1" Indicates a negative number.

### ■Mantissa (23 bits)

A mantissa means XXXXX... of  $1.XXXXX \times 2^N$  representing a single-precision real number in binary.

### ■Exponent (8 bits)

An exponent means N of  $1.XXXXX \times 2^N$  representing a single-precision real number in binary. The following table shows the relationships between the exponent value and N of a single-precision real number.

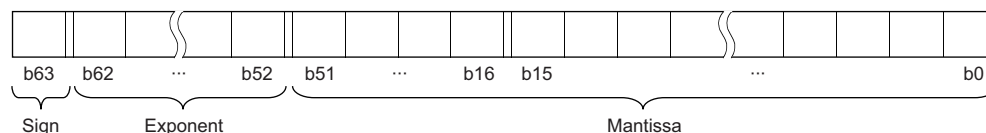
| Exponent (b24 to b30) | FFH      | FEH | FDH | ... | 81H | 80H | 7FH | 7EH | ... | 02H  | 01H  | 00H      |
|-----------------------|----------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|----------|
| N                     | Not used | 127 | 126 | ... | 2   | 1   | 0   | -1  | ... | -125 | -126 | Not used |

## Configuration of double-precision real number data

Double-precision real number data consists of a sign, mantissa, and exponent, and is expressed as shown below.



The following figure shows the bit configuration of the internal expression of double-precision real number data and the meaning of each part.



### ■Sign (1 bit)

This bit represents the positive or negative sign of a numerical value. "0" indicates a positive number or 0. "1" Indicates a negative number.

### ■Mantissa (52 bits)

A mantissa means XXXXX... of  $1.XXXXX... \times 2^N$  representing a single-precision real number in binary.

### ■Exponent (11 bits)

An exponent means N of  $1.XXXXX... \times 2^N$  representing a single-precision real number in binary. The following table shows the relationships between the exponent value and N of a single-precision real number.

| Exponent (b52 to b62) | 7FFH     | 7FEH | 7FDH | ... | 401H | 400H | 3FFH | 3FEH | ... | 02H   | 01H   | 00H      |
|-----------------------|----------|------|------|-----|------|------|------|------|-----|-------|-------|----------|
| N                     | Not used | 1023 | 1022 | ... | 2    | 1    | 0    | -1   | ... | -1021 | -1022 | Not used |

## Precautions

### ■When setting an input value of single-precision real number from the engineering tool

The number of significant digits is about 7 because the engineering tool processes single precision real number data in 32-bit single precision.

When the input value of single-precision real number data exceeds 7 digits, the 8th digit is rounded off.

Therefore, if the rounded-off value goes out of the range from -2147483648 to 2147483647, it will not be an intended value.

**Ex.**

When "2147483647" is set as an input value, it is handled as "2147484000" because 8th digit "6" is rounded off.

**Ex.**

When "E1.1754943562" is set as an input value, it is handled as "E1.175494" because 8th digit "3" is rounded off.

Set an input value within the following range. If the set value is out of the following range, a conversion error occurs.

Decimal point expression:  $0.0000000001 \leq \text{Absolute value of real number data} \leq 999999900000.0$

Exponential notation:  $1.175494351\text{E}-38 \leq \text{Absolute value of real number data} \leq 3.402823466\text{E}+38$



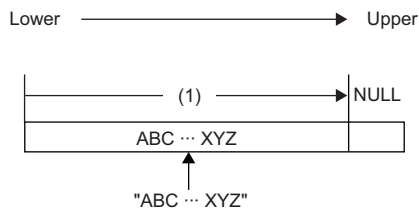
# String data

## Format of character string data

The following table lists the types of character string data, each of which ends with a NULL code to be handled as a character string.

| Type                     | Character code                   | Last character |
|--------------------------|----------------------------------|----------------|
| Character string         | ASCII code, Shift JIS code       | NULL(00H)      |
| Unicode character string | Unicode (UTF-16 (little endian)) | NULL(0000H)    |

Character string data is stored in devices or an array in ascending order of device numbers or array element numbers.



(1) Character code string

## Notation of character string

The following shows the notation of character strings in ladder programs.

| Data type                  | Notation | Example                                                                                         |
|----------------------------|----------|-------------------------------------------------------------------------------------------------|
| String                     | STRING   | Enclose a string (ASCII code, Shift JIS code) and Unicode string in double quotation marks ("). |
| Character string [Unicode] | WSTRING  | "ABC"                                                                                           |

The following shows the notation of character strings in ST programs.

| Data type                  | Notation | Example                                                                      |
|----------------------------|----------|------------------------------------------------------------------------------|
| String                     | STRING   | Enclose a string (ASCII code, Shift JIS code) in single quotation marks ('). |
| Character string [Unicode] | WSTRING  | Enclose a Unicode string in double quotation marks (").                      |

The following shows the notation of character strings in FBD/LD programs.

| Data type                  | Notation | Example                                                                      |
|----------------------------|----------|------------------------------------------------------------------------------|
| String                     | STRING   | Enclose a string (ASCII code, Shift JIS code) in single quotation marks ('). |
| Character string [Unicode] | WSTRING  | Enclose a Unicode string in double quotation marks (").                      |

## Data range

The following table summarizes the ranges of character string data.

| Type                                   | Maximum number of characters that can be set in a label        | Maximum number of characters that can be used for character string constant |
|----------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------|
| Character string                       | 255 single-byte characters (excluding the last NULL character) | 255 single-byte characters (excluding the last NULL character)              |
| Unicode character string <sup>*1</sup> | 255 characters (excluding the last NULL character)             | 255 characters (excluding the last NULL character)                          |

<sup>\*1</sup> For the Unicode character string, characters up to the basic multilingual plane can be used.



## Number of words required for storing data

Character string data can be stored in word devices.

The following table lists the numbers of words required for storing character string data.

| Number of character string bytes | Number of words required for storing character strings         | Number of words required for storing Unicode character strings |
|----------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|
| 0 byte                           | 1 [word]                                                       | 1 [word]                                                       |
| Odd number of bytes              | $(\text{Number of character string bytes} + 1) \div 2$ [words] | — (because one character is an even number of bytes)           |
| Even number of bytes             | $(\text{Number of character string bytes} \div 2) + 1$ [words] | Number of characters + 1 [words]                               |

## Character string data storage location

An image of the character string data storage location is shown below.

### ■Character strings

In each character string storage image, "NULL" indicates a NULL code (00H).

| Character string to be stored      | Image of storing character string data from D0                                                                                                                                            | Image of storing character string data from word type label array arrayA[0] |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|---|------|------------------------------------------------------------------------|------|---|-----------------------------------------------------------------------------------------------------------------------------------------|---|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---|---|---|---|---|------|---|------|
| Null character string ("") or ("") | D0 <table><tr><td>NULL</td><td>:</td><td>NULL</td></tr></table>                                                                                                                           | NULL                                                                        | : | NULL | arrayA[0] <table><tr><td>NULL</td><td>:</td><td>NULL</td></tr></table> | NULL | : | NULL                                                                                                                                    |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| NULL                               | :                                                                                                                                                                                         | NULL                                                                        |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| NULL                               | :                                                                                                                                                                                         | NULL                                                                        |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| ABC                                | D0 <table><tr><td>B</td><td>:</td><td>A</td></tr></table><br>D1 <table><tr><td>NULL</td><td>:</td><td>C</td></tr></table>                                                                 | B                                                                           | : | A    | NULL                                                                   | :    | C | arrayA[0] <table><tr><td>B</td><td>:</td><td>A</td></tr></table><br>arrayA[1] <table><tr><td>NULL</td><td>:</td><td>C</td></tr></table> | B | :    | A                                                                                                                                                                                                              | NULL | : | C |   |   |   |      |   |      |
| B                                  | :                                                                                                                                                                                         | A                                                                           |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| NULL                               | :                                                                                                                                                                                         | C                                                                           |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| B                                  | :                                                                                                                                                                                         | A                                                                           |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| NULL                               | :                                                                                                                                                                                         | C                                                                           |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| ABCD                               | D0 <table><tr><td>B</td><td>:</td><td>A</td></tr></table><br>D1 <table><tr><td>D</td><td>:</td><td>C</td></tr></table><br>D2 <table><tr><td>NULL</td><td>:</td><td>NULL</td></tr></table> | B                                                                           | : | A    | D                                                                      | :    | C | NULL                                                                                                                                    | : | NULL | arrayA[0] <table><tr><td>B</td><td>:</td><td>A</td></tr></table><br>arrayA[1] <table><tr><td>D</td><td>:</td><td>C</td></tr></table><br>arrayA[2] <table><tr><td>NULL</td><td>:</td><td>NULL</td></tr></table> | B    | : | A | D | : | C | NULL | : | NULL |
| B                                  | :                                                                                                                                                                                         | A                                                                           |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| D                                  | :                                                                                                                                                                                         | C                                                                           |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| NULL                               | :                                                                                                                                                                                         | NULL                                                                        |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| B                                  | :                                                                                                                                                                                         | A                                                                           |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| D                                  | :                                                                                                                                                                                         | C                                                                           |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |
| NULL                               | :                                                                                                                                                                                         | NULL                                                                        |   |      |                                                                        |      |   |                                                                                                                                         |   |      |                                                                                                                                                                                                                |      |   |   |   |   |   |      |   |      |

### ■Unicode character strings

In each Unicode character string storage image, "NULL" indicates a NULL code (0000H).

| Character string to be stored | Image of storing character string data from D0 | Image of storing character string data from word type label array arrayA[0] |
|-------------------------------|------------------------------------------------|-----------------------------------------------------------------------------|
| Null character string ("")    | D0 <div><div>NULL</div></div>                  | arrayA[0] <div><div>NULL</div></div>                                        |
| ABCD                          | D0 <div><div>A</div></div>                     | arrayA[0] <div><div>A</div></div>                                           |
|                               | D1 <div><div>B</div></div>                     | arrayA[1] <div><div>B</div></div>                                           |
|                               | D2 <div><div>C</div></div>                     | arrayA[2] <div><div>C</div></div>                                           |
|                               | D3 <div><div>D</div></div>                     | arrayA[3] <div><div>D</div></div>                                           |
|                               | D4 <div><div>NULL</div></div>                  | arrayA[4] <div><div>NULL</div></div>                                        |

# 1.3 Execution Condition

## Types of execution conditions

The following table lists the execution conditions of instructions.

| Execution condition |                                                                                   | Description <sup>*1</sup>                                                                                                                                                                                               |
|---------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| On                  |  | An instruction is executed during on. It is executed only while the precondition of the instruction is on. When the precondition is off, the instruction is not executed.                                               |
| Rising edge         |  | An instruction is executed one time when turned on. It is executed only once on the rising edge (off to on) of the precondition of the instruction and is no longer executed later even when the condition turns on.    |
| Off                 |  | An instruction is executed during off. It is executed only while the precondition of the instruction is off. When the precondition is on, the instruction is not executed.                                              |
| Falling edge        |  | An instruction is executed one time when turned off. It is executed only once on the falling edge (on to off) of the precondition of the instruction and is no longer executed later even when the condition turns off. |
| Every scan          | —                                                                                 | An instruction is always executed regardless of whether the precondition of the instruction is on or off. When the precondition is off, the instruction performs off processing.                                        |

<sup>\*1</sup> When the program is described in structured text language (ST) or function block diagram/ladder diagram (FBD/LD), EN will be the precondition of the instruction.

## Execution condition of each instruction

The execution condition varies depending on the instruction. For execution condition, refer to the details of each instruction in this manual.

When the program is described in structured text language (ST) or function block diagram/ladder diagram (FBD/LD), EN will be the execution condition. The instruction is executed only when EN is TRUE. The status of ENO will be the same as that of EN.

Note that the execution condition of standard functions and function blocks differs depending on the existence of EN. If there is no EN, the standard function or function block is executed at every scan. For the execution condition of the standard function or function block with EN, refer to the details of each standard function or function block in this manual.

For the execution conditions on the motion control function blocks, refer to the following.

 Page 1431 Execution command (Execute) type/Enable (Enable) type

# 1.4 Precautions on Programming

## Errors common to instructions

The following table lists the conditions under which an error occurs when the instruction is executed.

| Error description <sup>*1</sup>                                                                                                                                                                                                                                                                             | Error code |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| An I/O number which is out of range (other than 000H to FFFH and 3E0H to 3E3H) is specified.                                                                                                                                                                                                                | 2800H      |
| An I/O number which corresponds to no module is specified.                                                                                                                                                                                                                                                  | 2801H      |
| An I/O number of the module that cannot be specified by using the instruction is specified.                                                                                                                                                                                                                 | 2803H      |
| A network number which is out of range (1 to 239) is specified.                                                                                                                                                                                                                                             | 2804H      |
| A network number which does not exist is specified.                                                                                                                                                                                                                                                         | 2805H      |
| <ul style="list-style-type: none"> <li>The device or label specified by the instruction exceeds the available range.</li> <li>The file register is accessed while the file register is not set in the file setting of a CPU parameter or the file register to be used in the program is not set.</li> </ul> | 2820H      |
| <ul style="list-style-type: none"> <li>The range of the buffer memory of the module specified by the instruction is exceeded.</li> <li>The module specified by the instruction does not have buffer memory.</li> </ul>                                                                                      | 2823H      |

\*1 For a contact instruction, an error is not detected but the operation result becomes no continuity.

## Checking the ranges of instruction runtime devices and labels

### Device range check

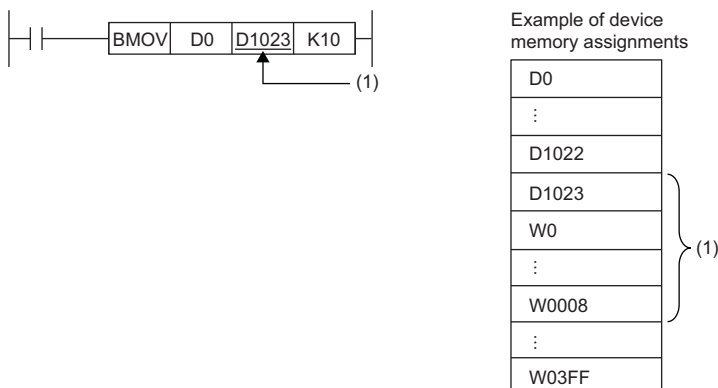
When a device is specified in an instruction, range check is performed, so a program needs to be created so that the operation result falls within the range of the relevant device.

If a range exceeding that of the relevant device is specified, an error (error code: 2820H) occurs.

The same applies if the label assigned to a device is specified in an instruction in the program.

**Ex.**

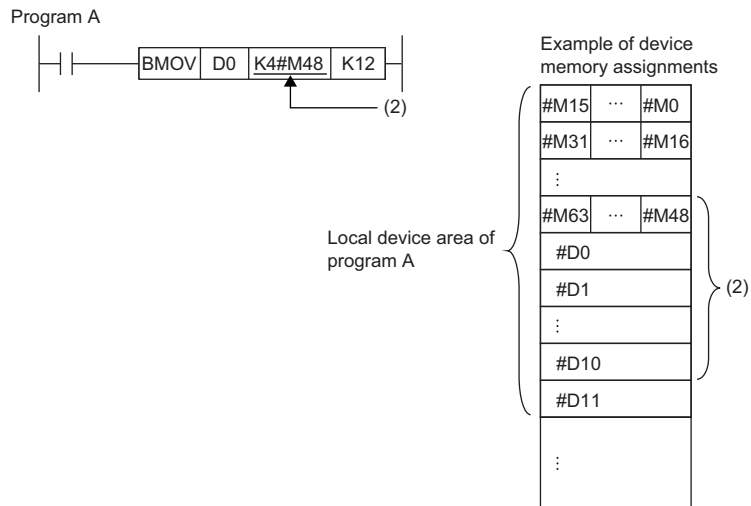
When W0 is assigned after global device D1023 in the device memory



(1) The transfer destination is in the range corresponding to D1023 to D1032. An error occurs because the range from D1024 to D1032 does not exist.

**Ex.**

When local devices are set in the range from M0 to M63 or D0 to D11



- (2) The transfer destination is in the range corresponding to local devices #M48 to #M239 of program A. An error occurs because the range from M64 to #M239 does not exist.

## Checking the range of file register

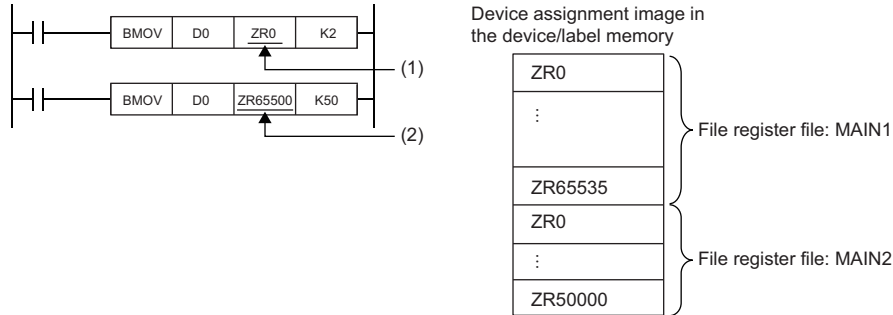
When a file register is specified in an instruction, a range check is performed, so a program needs to be created so that the operation result falls within the range of the relevant file register.

If a range exceeding that of the file register (ZR) is specified, an error (error code: 2820H) occurs.

If a range exceeding that of the file register of the block number used by the file register (R) is specified, an error (error code: 2820H) occurs.

### Ex.

When a file register (ZR) is specified

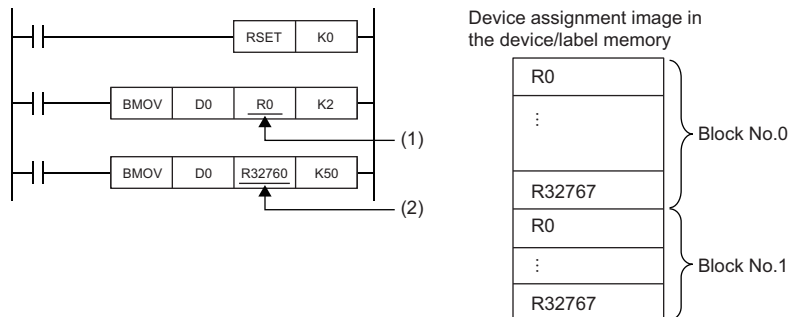


(1) The transfer destination is in the range of file register MAIN1. Data is written to ZR0 and ZR1.

(2) The transfer destination is out of the range of file register MAIN1. An error occurs because the area range of file register MAIN1 is exceeded.

### Ex.

When a file register (R) is specified



(1) The transfer destination is in the range of the R device of block number 0. Data is written to R0 and R1.

(2) The transfer destination is out of the range of the R device of block number 0. An error occurs because the area range of the R device of block number 0.

Global (latch) label and local (latch) label range check

When a global (latch) label or local (latch) label is specified in an instruction, range check is performed, so a program needs to be created so that the operation result falls within the range of the relevant label. For digit specification or bit specification as well, specify a value within the range of the relevant label.

If a range exceeding that of the relevant device is specified, an error (error code: 2820H) occurs.

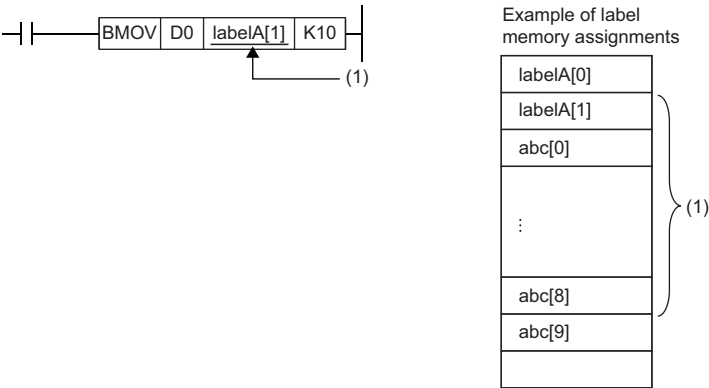
■Array label

When an array label is specified for an argument, the entire array label is checked. When elements of an array label are specified as well, values within the range of the array label are checked.

Ex.

When labels are arrayed as follows

| Label name | Data type            | Number of array elements |
|------------|----------------------|--------------------------|
| labelA     | Bit string [16 bits] | 2                        |
| abc        | Bit string [16 bits] | 10                       |



(1) The transfer destination is in the range corresponding to 10 points from labelA[1]. An error occurs because the range from labelA[2] to labelA[9] does not exist.

## ■ Structure type label

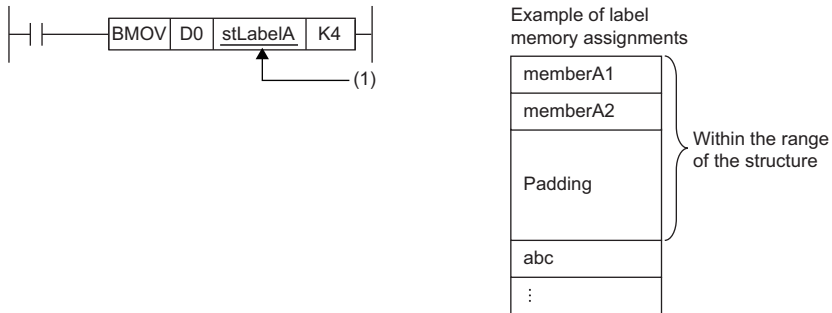
When a structure type label is specified for an argument, the entire structure type label is checked. When a structure member is specified, values within the range that corresponds to the data type of the relevant member are checked.

**Ex.**

When labels are arrayed as follows

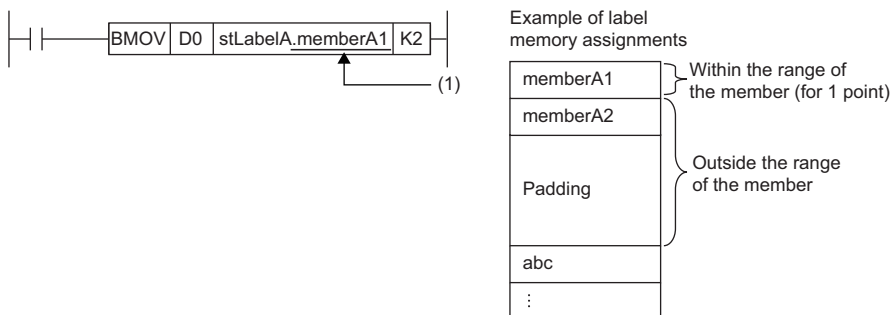
| Label name | Data type                 |                           | Member   |
|------------|---------------------------|---------------------------|----------|
| stLabelA   | Structure A               | Word/bit string [16 bits] | memberA1 |
|            |                           | Word/bit string [16 bits] | memberA2 |
| abc        | Word/bit string [16 bits] |                           | —        |

- When a structure type label is specified



(1) The transfer destination is in the range corresponding to 4 points from the start of the structure type label "stLabelA". Because access is in the range that includes two points for padding in the structure, data is written.

- When the member "memberA1" is specified



(1) The transfer destination is in the range corresponding to 2 points from the start of memberA1. Because the range of memberA1 corresponds to one point, an error occurs.

Module label and network label range check

When a module label or network label is specified in an instruction, range check is performed in the network label/module label assignment area. Therefore, create a program so that the operation result falls within the range of the network label/module label assignment area.

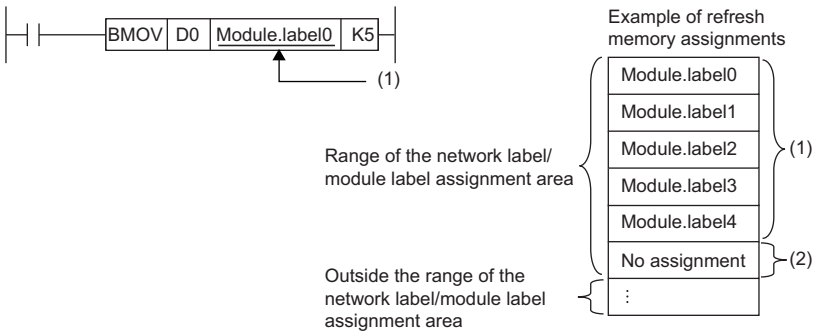
If a range exceeding that of the relevant network label/module label assignment area is specified, an error (error code: 2820H) occurs.

For details on the setting method of the network label/module label assignment area, check the user's manual for the controller used.

Ex.

When module labels are set as follows

| Instance name | Label name | Data type       | Assignment device |
|---------------|------------|-----------------|-------------------|
| Module        | label0     | Word [unsigned] | UV: 0             |
|               | label1     | Word [unsigned] | UV: 1             |
|               | label2     | Word [unsigned] | UV: 2             |
|               | label3     | Word [unsigned] | UV: 3             |
|               | label4     | Word [unsigned] | UV: 4             |



- (1) The transfer destination is within the range of the network label/module label assignment area. It is written to Module.label0 to Module.label4. Data is written even if the data type is crossed.
- (2) Although the area is outside the transfer destination range, it is within the network label/module label assignment area, so this area can be accessed.



# Operation when a long timer or long retentive timer device is used

When the data to be handled exceeds the width (32 bits) of the current value, the long timer or long retentive timer operates by using not only the area of the current value but also the areas of the previous value, contact, and coil.

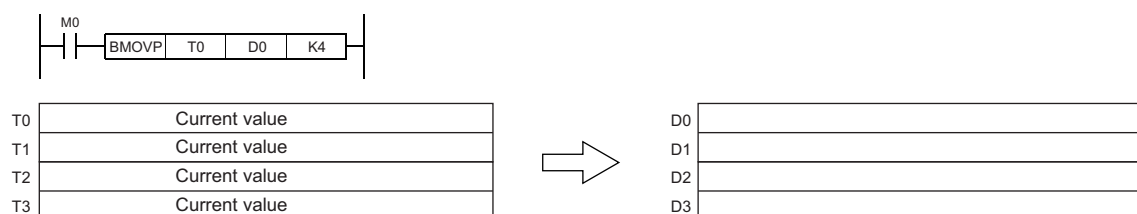
| Device                     | Configuration                                                                                                                                                                                                                  |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Timer (T)                  | <div> <div>T0</div> <div>T0</div> </div>                                                                                                                                                                                       |
| Retentive timer (ST)       | <div> <div>.....</div> <div>Contact</div> <div>Coil</div> </div>                                                                                                                                                               |
| Counter (C)                | <div> <div>Current value</div> <div>T0</div> <div>.....</div> <div>T1</div> <div>Current value</div> <div>T2</div> </div>                                                                                                      |
| Long timer (LT)            | <div> <div>Current value</div> <div>LT0</div> <div>FRT previous value</div> <div>Contact</div> <div>Coil</div> <div>Current value</div> <div>LT1</div> <div>FRT previous value</div> <div>Contact</div> <div>Coil</div> </div> |
| Long retentive timer (LST) |                                                                                                                                                                                                                                |
| Long counter (LC)          | <div> <div>LC0</div> <div>LC0</div> <div>.....</div> <div>Contact</div> <div>Coil</div> <div>Current value</div> <div>LC0</div> <div>Current value</div> <div>LC1</div> </div>                                                 |

When the BMOV instruction is used to batch-transfer current values, current values alone cannot be batch-transferred. Batch-transfer the current values, contacts, and coils altogether and, after the batch transfer is finished, use only the current values. When the DMOV instruction is used to batch-transfer current values, repeat the transfer of the current values alone using the FOR to NEXT instruction.

## Ex.

To batch-transfer the current values of the timer device

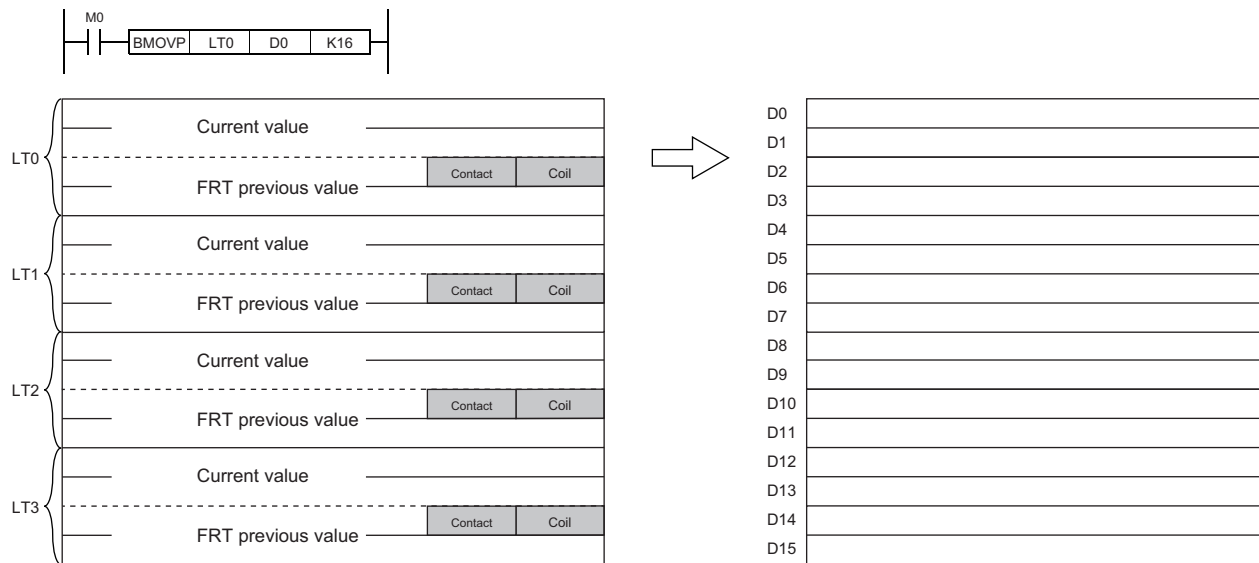
When the BMOV instruction is used, only current values are batch-transferred.



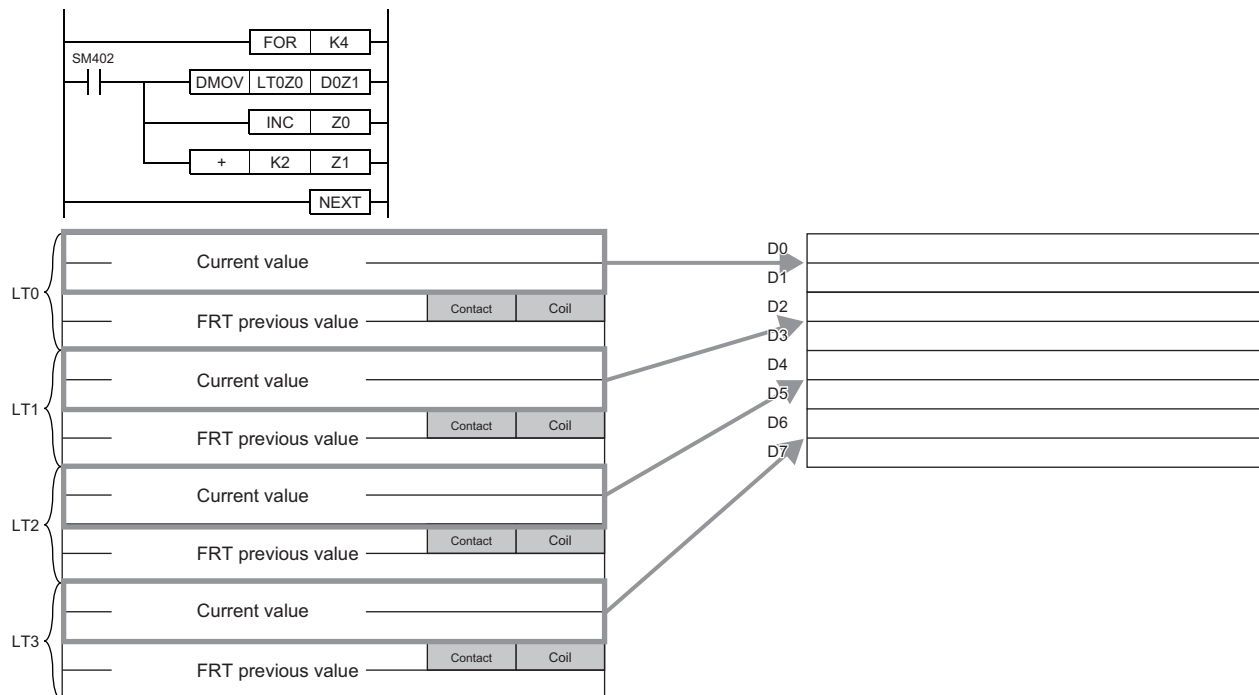
**Ex.**

To batch-transfer the current values of the long timer device

When the BMOV instruction is used, all current values, contacts, and coils are batch-transferred.



When the DMOV instruction is used, only current values are batch-transferred.



## Precautions for using a link device assigned to a synchronized station as an instruction argument

When using a link device assigned to a synchronized station in CC-Link IE TSN as an instruction argument, set link refresh and then specify the refresh target device or label. If direct access device (U□\G□, J□\□) is specified to an instruction argument, the link device does not operate correctly.

For details on CC-Link IE TSN, check the user's manual for the controller used.

## Operations arising when the OUT, SET/RST, and PLS/PLF instructions of the same device are used

This section describes the operation when two or more OUT, SET/RST, and PLS/PLF instructions that use the same device are executed within one scan.

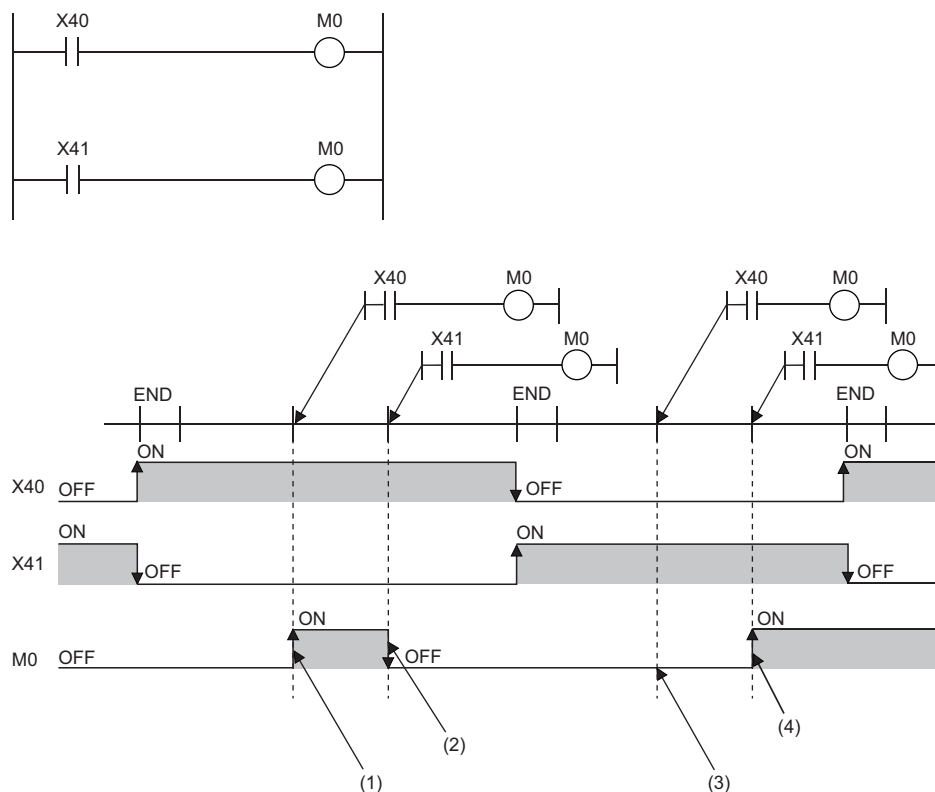
### For OUT instructions of the same device

More than one OUT instruction of the same device must not be issued during one scan.

Otherwise, the specified device turns on or off, depending on the operation result up to each OUT instruction while it is in execution.

In this case, the device may turn on/off during one scan because the on/off state of the specified device is determined during execution of each OUT instruction.

The following figure shows the behavior arising when a circuit turning on/off the same internal relay (M0) is created with input X40 and X41.



- (1) Since X40 is on, M0 turns on.
- (2) Since X41 is off, M0 turns off.
- (3) Since X40 is off, M0 remains off.
- (4) Since X41 is on, M0 turns on.

If output (Y) is specified using an OUT instruction, the on/off state of the last OUT instruction executed during the one scan will be output.

## If SET/RST instructions of the same device are used

### ■For SET instructions

The SET instruction turns on the specified device if the execution command is on, and causes no operation if it is off.

Thus, if two or more SET instructions of the same device are executed during one scan, the specified device turns on even if one execution command is on.

### ■For RST instructions

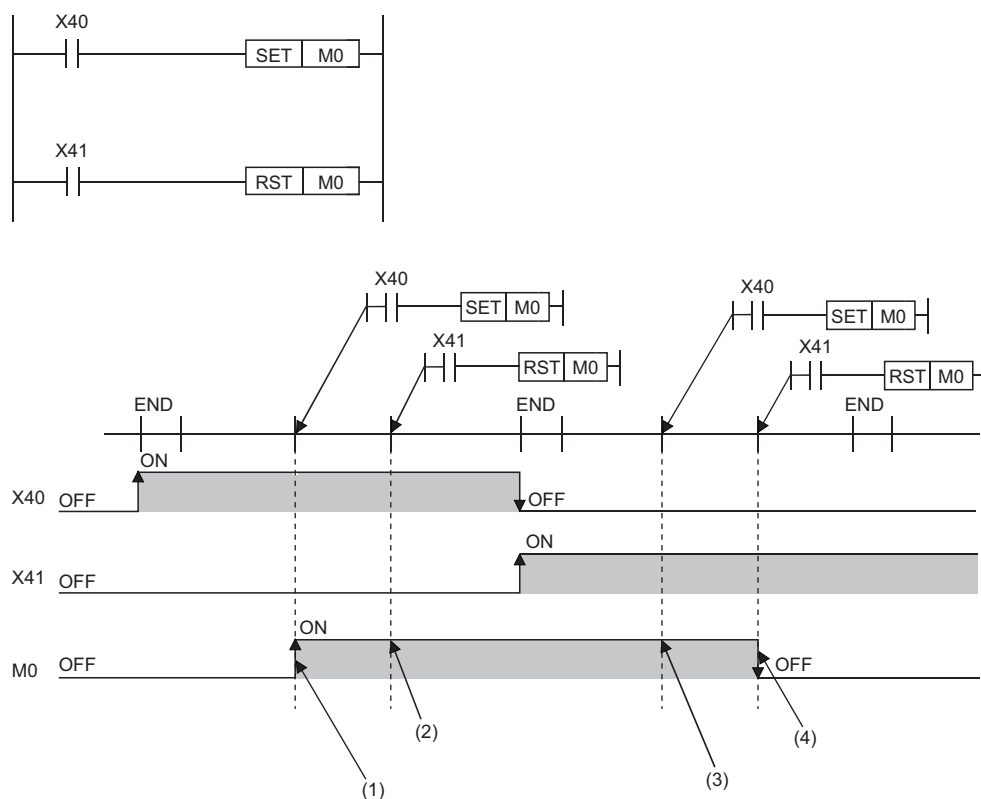
The RST instruction turns on the specified device if the execution command is off, and causes no operation if it is off.

Thus, if two or more RST instructions of the same device are executed during one scan, the specified device turns on even if one execution command is off.

### ■If the SET and RST instructions of the same device exist in one scan

If the SET and RST instructions of the same device exist in one scan, the SET instruction turns on the specified device if the execution command is on, and turns off the specified device if it is on.

If both the SET and RST instructions are off, the on/off state of the specified device will be unchanged.



(1) Since X40 is on, M0 turns on.

(2) Since X41 is off, M0 remains on. (The RST instruction results in non-processing.)

(3) Since X40 is off, M0 remains on. (The SET instruction results in non-processing.)

(4) Since X41 is on, M0 turns off.

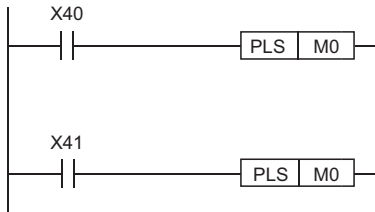
If output (Y) is specified using a SET/RST instruction, the on/off state of the last SET/RST instruction executed during the one scan will be output.

## If PLS instructions of the same device are used

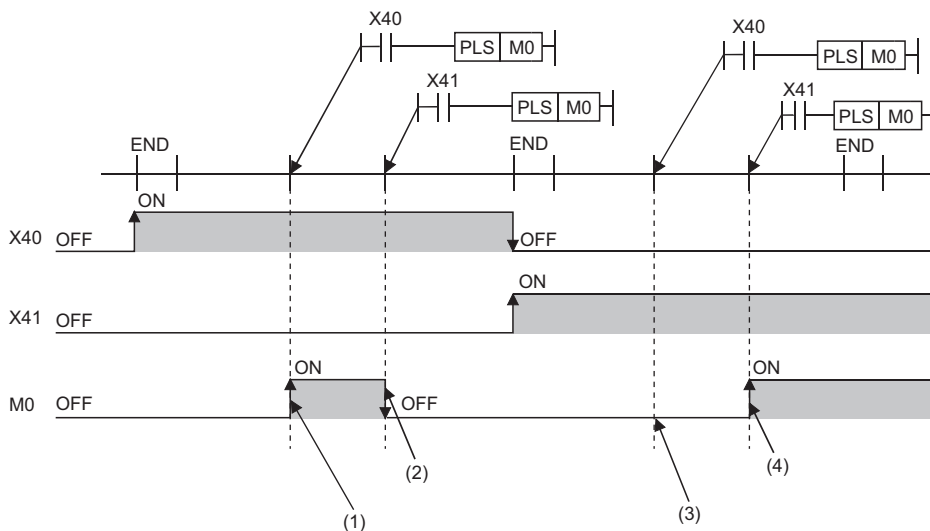
The PLS instruction turns on the specified device when the execution command specifies an off-to-on change. The specified device is turned off unless the execution command specifies an off-to-on change (i.e. off to off, on to on, on to off).

Thus, if two or more PLS instructions of the same device are issued during one scan, the specified device is turned on when the execution command of each PLS instruction specifies an off-to-on change. The specified device is turned off unless the execution command specifies an off-to-on change.

Thus, if two or more PLS instructions are issued during one scan, the device turned on by a PLS instruction may not turn on for one scan.

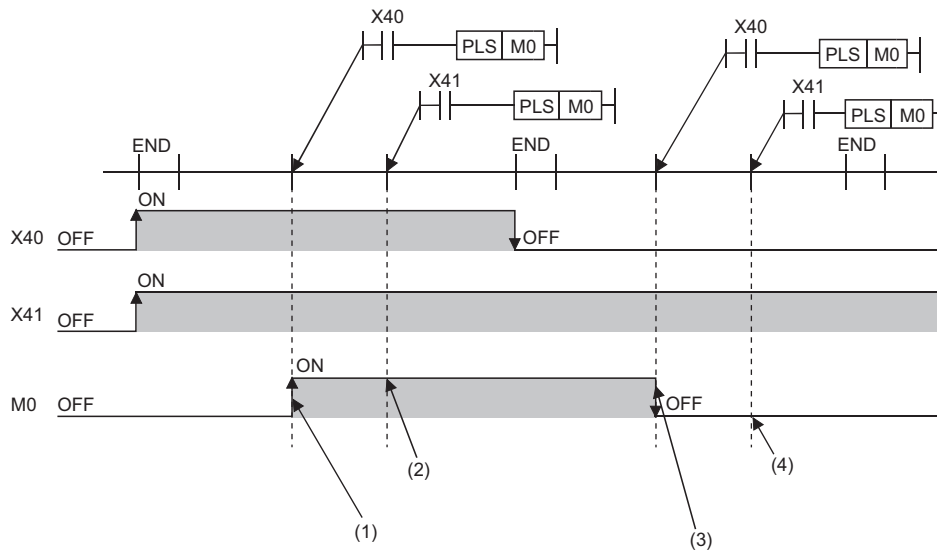


- If X40 and X41 differ in the on/off timing (i.e. the specified device does not turn on for one scan)



- (1) Since X40 turns on, M0 turns on.
- (2) Since X41 is other than turning on, M0 turns off.
- (3) Since X40 is other than turning on, M0 remains off.
- (4) Since X41 turns on, M0 turns on.

- If the off-to-on changes of X40 and X41 are at the same timing



- (1) Since X40 turns on, M0 turns on.
- (2) Since X41 turns on, M0 remains off.
- (3) Since X40 is other than turning on, M0 turns off.
- (4) Since X41 is other than turning on, M0 remains off.

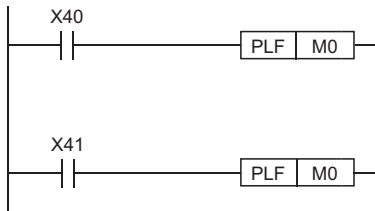
If output (Y) is specified using a PLS instruction, the on/off state of the last PLS instruction executed during the one scan will be output.

## If PLF instructions of the same device are used

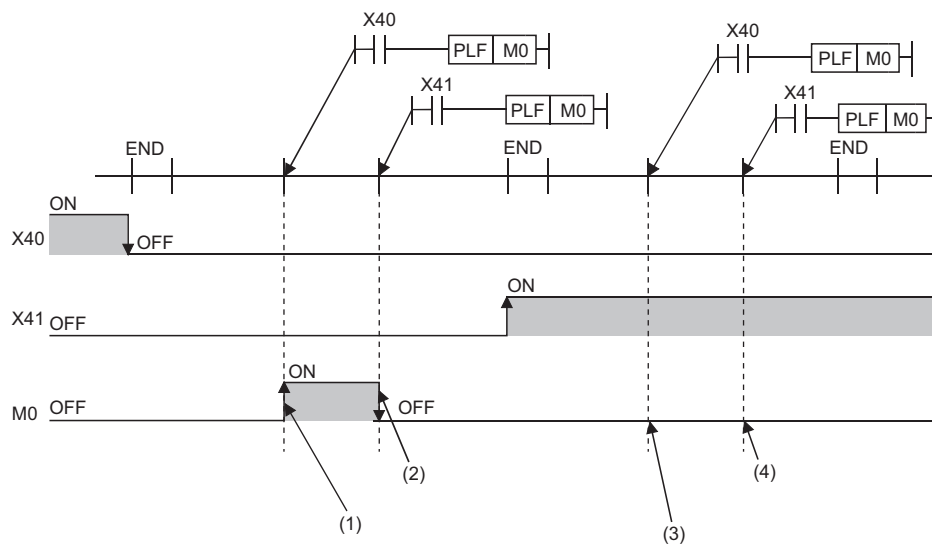
The PLF instruction turns on the specified device when the execution command specifies an off-to-on change. The specified device is turned off unless the execution command specifies an on-to-off change (i.e. off to off, off to on, on to on).

Thus, if two or more PLF instructions of the same device are issued during one scan, the specified device is turned on when the execution command of each PLF instruction specifies an on-to-off change. The specified device is turned off unless the execution command specifies an on-to-off change.

Thus, if two or more PLF instructions are issued during one scan, the device turned on by a PLF instruction may not turn on for one scan.

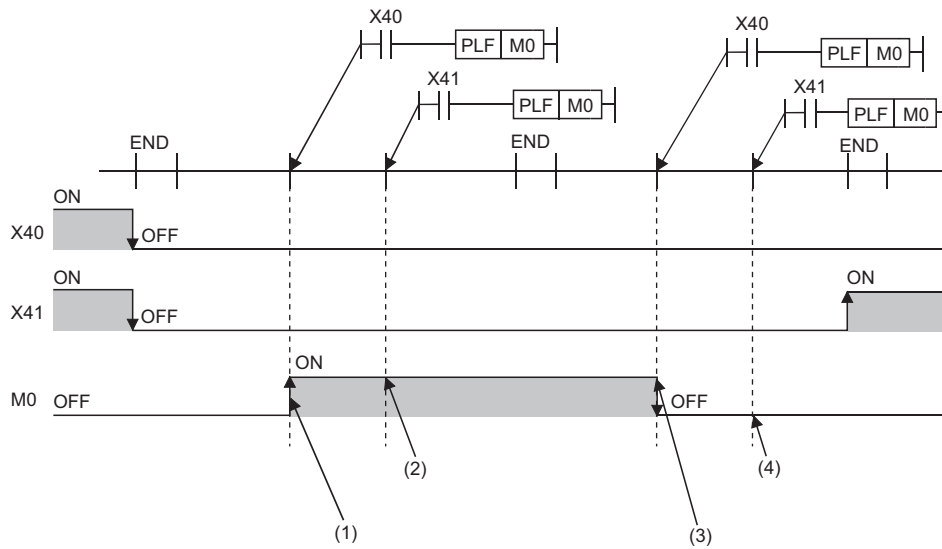


- If X40 and X41 differ in the on/off timing (i.e. the specified device does not turn on for one scan)



- (1) Since X40 turns off, M0 turns on.
- (2) Since X41 is other than turning off, M0 turns off.
- (3) Since X40 is other than turning off, M0 remains off.
- (4) Since X41 is other than turning off, M0 remains off.

- If the on-to-off changes of X40 and X41 are at the same timing



- (1) Since X40 turns off, M0 turns on.
- (2) Since X41 turns off, M0 remains on.
- (3) Since X40 is other than turning off, M0 turns off.
- (4) Since X41 is other than turning off, M0 remains off.

If output (Y) is specified using a PLF instruction, the on/off state of the last PLF instruction executed during the one scan will be output.



# Restrictions on using file registers

When a file register is specified for the refresh device, note the following restrictions.

1

## When the block number is changed by the RSET instruction

When the block number is changed by the RSET instruction, note the following.

- Data is refreshed by the file register (R) of the new block number.
- Data is refreshed by the file register (R) of the block number immediately before refresh.

To read or write refresh data, specify the block number immediately before refresh.

# 2

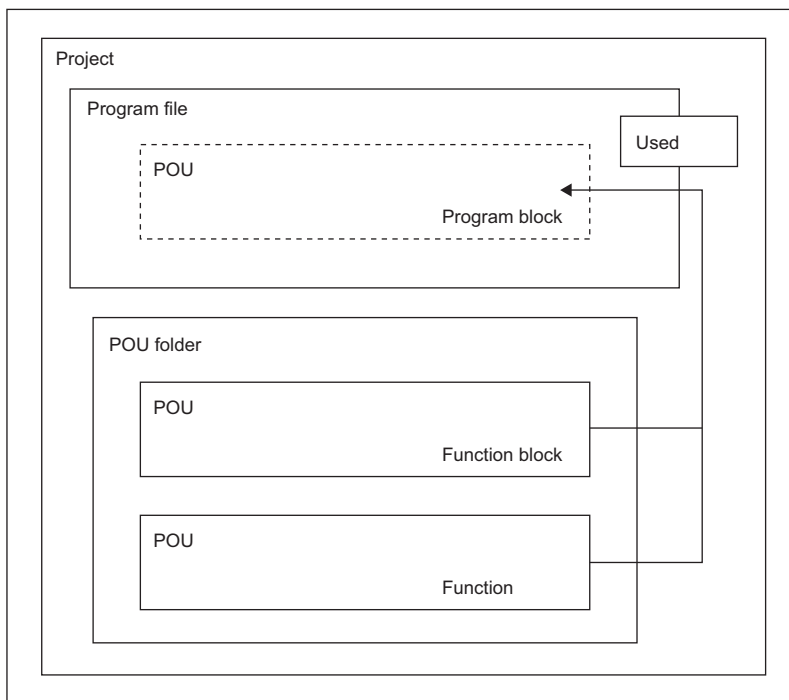
## PROGRAM ORGANIZATION UNITS

There are three types of program organization units (POUs).

- Program block
- Function
- Function block

Processing can be described in the programming language that suits the control performed in each POU. Processing can be described in the ladder diagram, structured text language, or FBD/LD in a function or a function block.

Functions and function blocks are called and executed by program blocks.



### Point

A structured program is a program created by components. Processes in lower levels of hierarchical sequence program are divided into several components according to their processing information and functions.

Each component of a program is specified to have a high degree of independence for easy addition and replacement.

The following are the examples of processing that would be ideal to be structured.

- Processing which is used repeatedly in a program
- Processing which can be separated as one function

This chapter describes two types of POUs using labels.

Devices can also be used in the program (worksheet) of each POU. For details on devices, refer to the following.

User's manual for the controller used

### Point

Up to 32 worksheets can be created in one POU in the structured text language and FBD/LD.

Set the execution order of multiple worksheets on the "Worksheet Execution Order Setting" window of the engineering tool. ( GX Works3 Operating Manual)

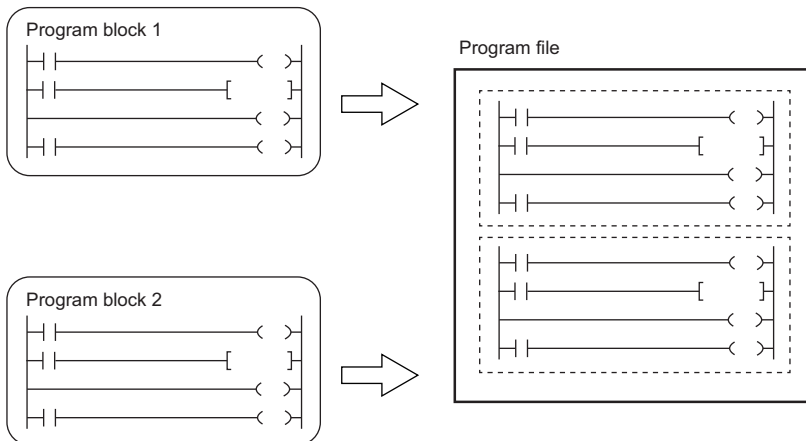
## 2.1 Program Blocks

A program block is a unit for making up a program.

Multiple program blocks can be created in a program file and executed in the order specified in the program file setting. If the order is not specified in the program file setting, the program blocks are executed in ascending order of their names.

By separating program blocks for individual functions and processing, the order of programs can be changed easily and programs can be exchanged easily.

The program of a program block is stored by each registration destination program in a program file.



### Dividing into program blocks

A main routine program, subroutine program, and interrupt program can be created separately in individual program blocks.

| Program type         | Description                                                                                                                                                                                                  |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Main routine program | A program beginning with step 0 and ending with the FEND instruction                                                                                                                                         |
| Subroutine program   | A program beginning with a pointer (P) and ending with the RET instruction.<br>This program is executed only when it is called by a subroutine call instruction (such as the CALL and ECALL instructions).   |
| Interrupt program    | A program beginning with an interrupt pointer (I) and ending with the IRET instruction.<br>When an interrupt factor occurs, the interrupt program corresponding to the interrupt pointer number is executed. |

#### Point

- Create a subroutine program and interrupt program after the FEND instruction of the main routine program. Any program after the FEND instruction is not executed as a main routine program. For example, when the FEND instruction is used at the end of the second program block, the third program block or later runs as a subroutine program or interrupt program.
- To create an easy-to-understand program, use a pair of instructions, such as the FOR and NEXT instructions or the MC and MCR instructions, within a single program block.
- A simple program can be executed in the controller simply by writing the main routine in one program block.

For details on the subroutine program and interrupt program, refer to the following.

User's manual for the controller used

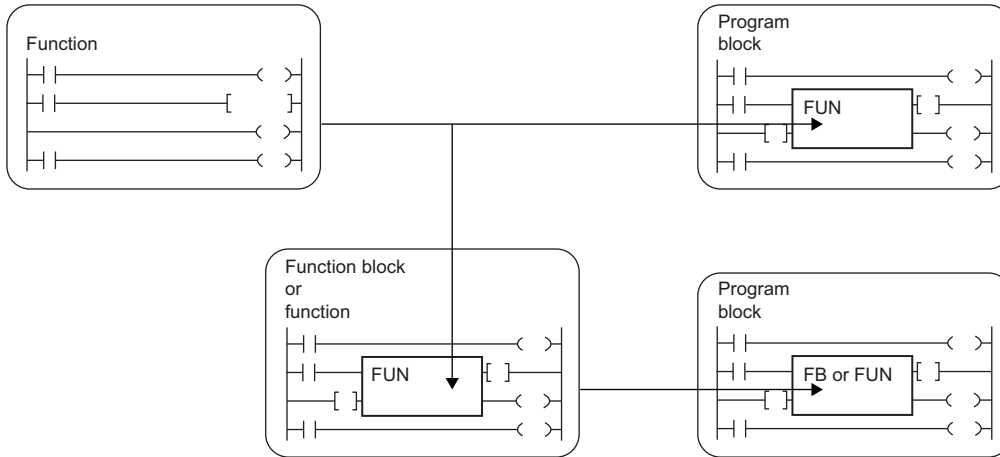
## 2.2 Functions (FUN)

A function is a POU called and executed by program blocks, function blocks, and other functions.

After the processing completes, a function passes a value to the calling source. This value is called a return value.

A function always outputs the same return value, as the processing result, for the same input.

By defining simple, independent algorithms that are frequently used, functions can be reused efficiently.



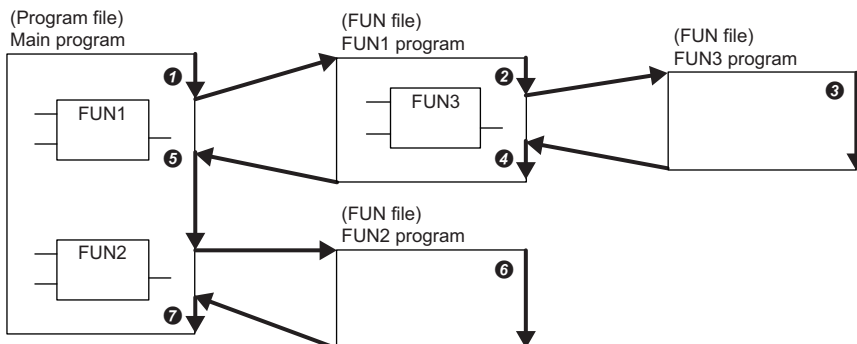
### Operation overview

The program of a function is stored in the FUN file and called by the calling source program when executed.

**Ex.**

When calling FUN1 and FUN2 from the main program, and calling FUN3 by FUN1 (Nested three times)

➊ to ➋ indicate the execution flow (order).

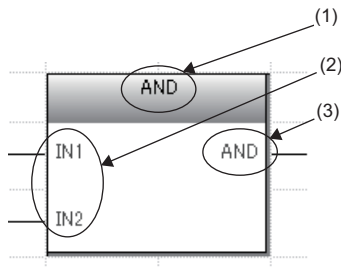


Up to 32 subroutine type function blocks and functions in total can be nested.

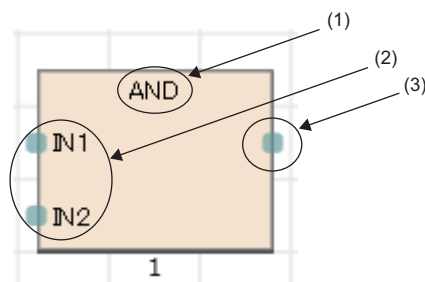
## Input variables and output variables

Input and output variables can be defined in functions. Output data which is different from the return value can be assigned to the output variable.

Ladder program



FBD/LD program



- (1) Function name
- (2) Input variable
- (3) Output variable

The return value of the function is not displayed.

Input variables are set in the VAR\_INPUT class and output variables are set in the VAR\_OUTPUT class.

### Point

Variables defined in the function are overwritten every time the function is called.

To hold the data in the variables, create a program by using function blocks or so that the data in the output variable is saved in another variable.

## EN and ENO

EN (enable input) and ENO (enable output) can be appended to a function to control execution processing.

- Set a boolean variable used as an execution condition of a function to EN.
- A function with EN is executed only when the execution condition of EN is TRUE.
- Set a boolean variable used to output a function execution result to ENO.

The following table lists the ENO states and operation results according to the EN states.

| EN                   | ENO   | Operation result              |
|----------------------|-------|-------------------------------|
| TRUE (executed)      | TRUE  | Operation result output value |
| FALSE (not executed) | FALSE | Undefined value               |

### Point

- Setting an output label to ENO is not always required for the program written in ladder or FBD/LD.
- When EN/ENO is used in a standard function, the function with EN is represented by "function-name\_E".

## Creating programs

The program of a function can be created by using the engineering tool.

 [Navigation window] ⇒ [FB/FUN] ⇒ Right-click ⇒ [Add New Data]  
Select "Function" for "Data Type" in "Basic Setting".

The created program is stored in the FUN file.

 [CPU Parameter] ⇒ [Program Setting] ⇒ [FB/FUN File Setting]

Up to 64 created programs can be stored in one FUN file.

The rising edge execution instruction or falling edge execution instruction cannot be used in the function.

For details on program creation, refer to the following.

| Item                                                       | Reference                                                                                                               |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| How to create function programs                            |  GX Works3 Operating Manual            |
| Number of FB/FUN files that can be written to a controller |  User's manual for the controller used |

### ■Applicable devices and labels

The following table lists the devices and labels that can be used in function programs.

○: Applicable, △: Applicable only in instructions (Cannot be used to indicate the program step.), ×: Not applicable

| Type of device/label                |                           | Availability |
|-------------------------------------|---------------------------|--------------|
| Label (other than the pointer type) | Global label              | ×            |
|                                     | Local label               | ○*1          |
| Label (pointer type)                | Pointer type global label | ×            |
|                                     | Pointer type local label  | ○            |
| Device                              | Global device             | ○            |
|                                     | Local device              | ×            |
| Pointer                             | Global pointer            | △            |
|                                     | Local pointer             | ×            |

\*1 The following data types cannot be used.

Timer, retentive timer, counter, long timer, long retentive timer, and long counter

#### Point

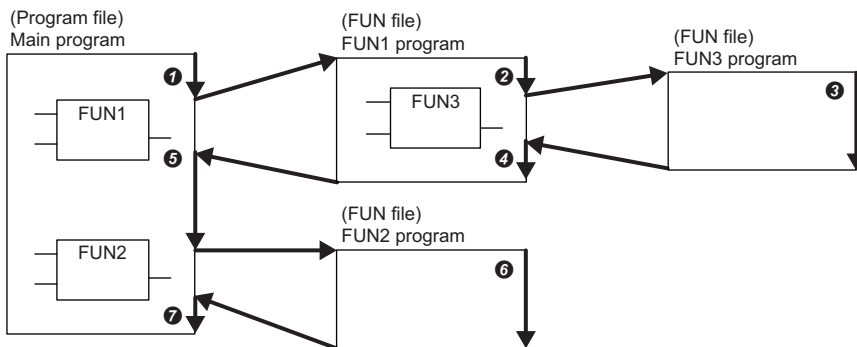
- Program a function name as a label in a function to set a return value of the function. Setting function names as labels is not necessary. The data type set in "Result Type" in the properties of the function can be used.

## Labels defined by a function

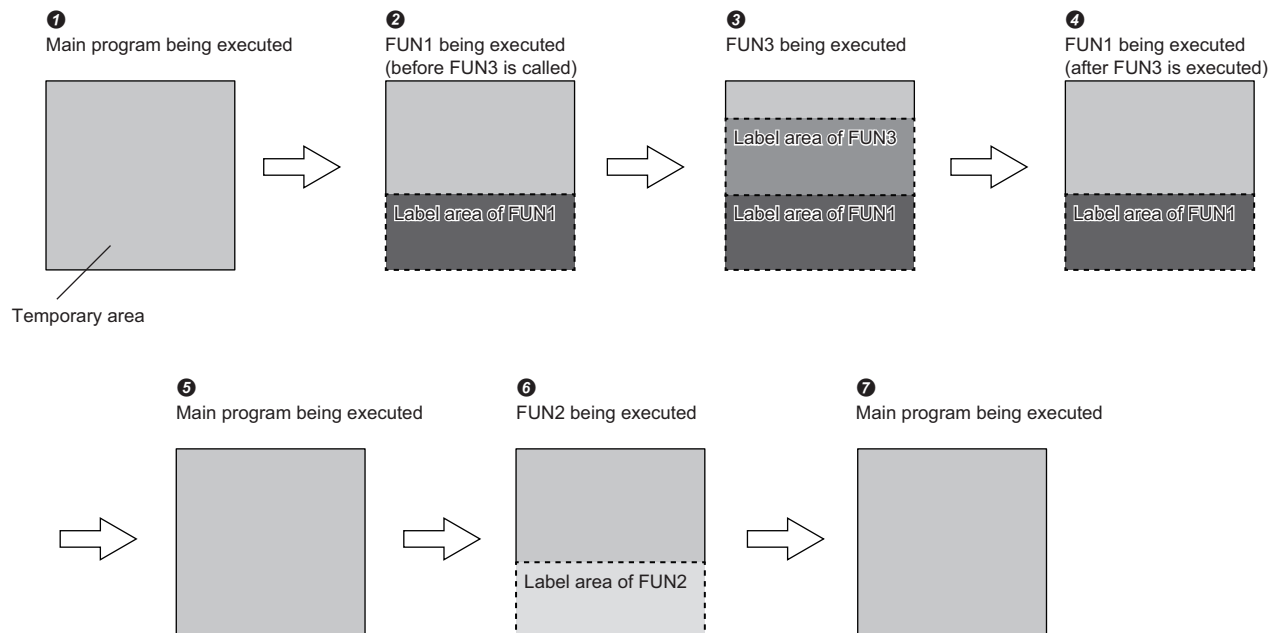
The labels defined by a function are assigned in the temporary areas of the storage-target memory during execution of the function, and the areas are freed after the processing completes.

**Ex.**

When calling FUN1 and FUN2 from the main program, and calling FUN3 by FUN1 (① to ⑦ indicate the execution flow (order).)



The following figure shows the label assignments while the above functions are being executed.



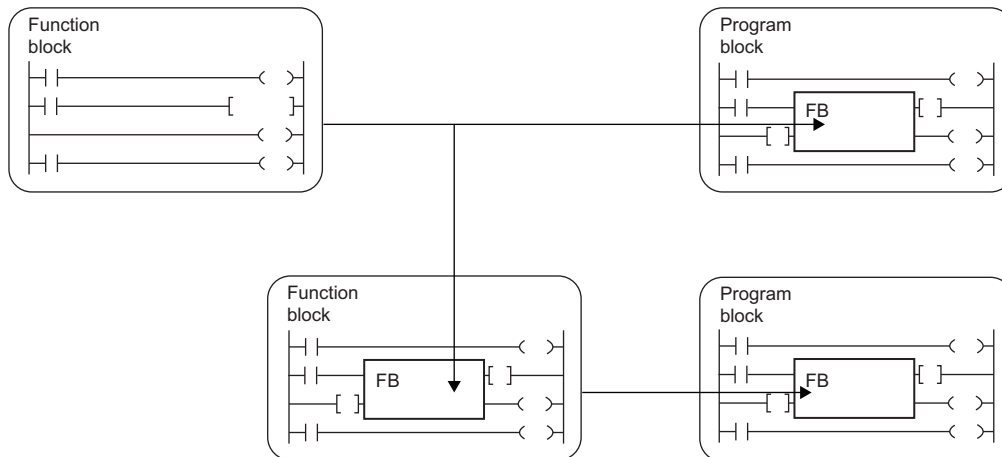
The class of labels that can be defined in the function are VAR, VAR\_CONSTANT, VAR\_INPUT, and VAR\_OUTPUT.

### Point

The label to be defined by a function must be initialized by a program before the first access because the label value will be undefined.

## 2.3 Function Blocks (FB)

A function block is a POU called and executed by program blocks and other function blocks.

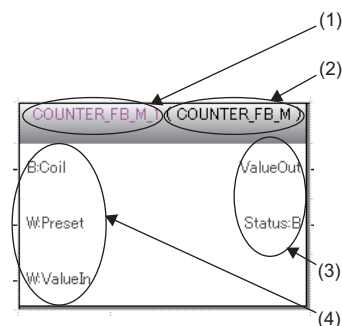


Unlike a function, a function block does not have a return value.

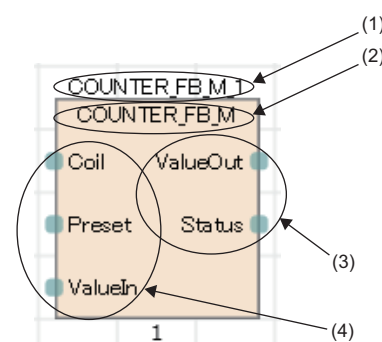
A function block can hold values in variables and thus can hold input states and processing results.

A function block uses the value it holds for the next processing and therefore it does not always output the same result even with the same input value.

Ladder program



FBD/LD program



- (1) Instance name
- (2) Function block name
- (3) Output variable
- (4) Input variable

A function block needs to be instantiated to be used in programs.

Page 69 Instances

### Point

For details on module function blocks, refer to the following.

Function Block Reference for the module used



## Operation overview

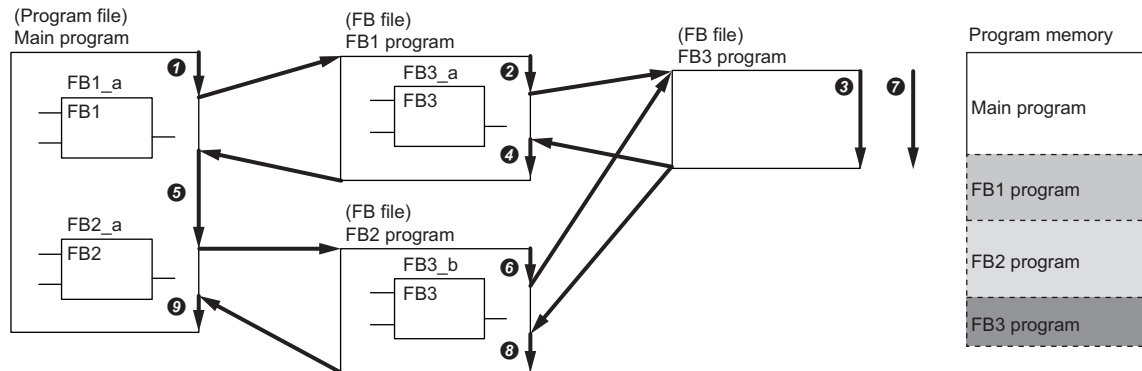
### ■ Subroutine type function blocks

The program of a subroutine type function block is stored in the FB file and called by the calling source program when executed.

#### Ex.

When calling FB1\_a and FB2\_a from the main program, calling FB3\_a by FB1\_a, and calling FB3\_b by FB2\_a (Nested three times)

① to ⑨ indicate the execution flow (order).

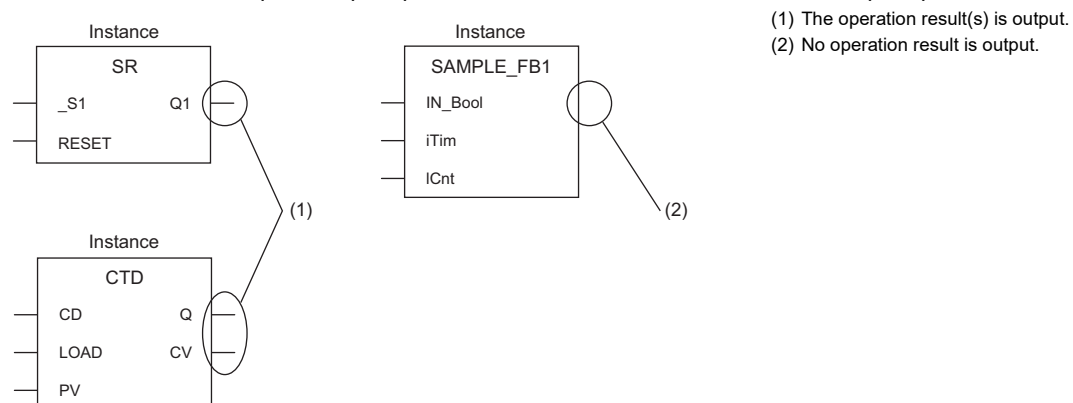


Up to 32 subroutine type function blocks and functions in total can be nested.

## Input variables, output variables, and input/output variables

Input variables, output variables, and input/output variables need to be defined in function blocks.

A function block can output multiple operation results. It can also be set not to output operation results.



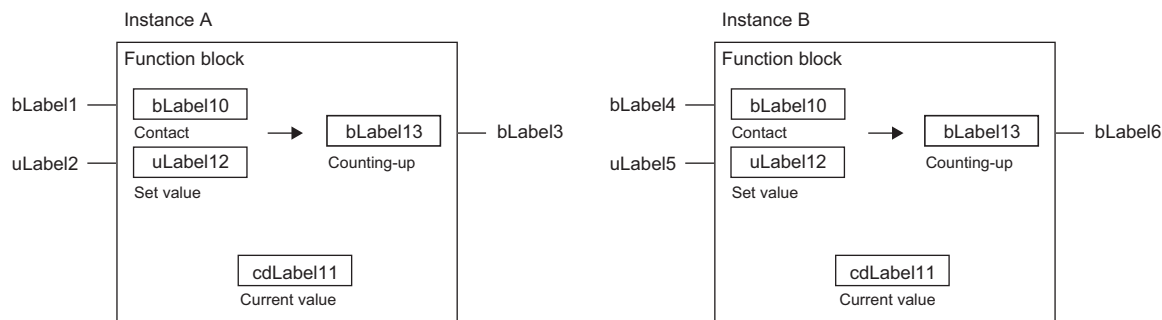
- (1) The operation result(s) is output.
- (2) No operation result is output.

Input variables are set in the VAR\_INPUT class, output variables are set in the VAR\_OUTPUT class and VAR\_OUTPUT\_RETAIN class, and input/output variables are set in the VAR\_IN\_OUT class.

## Internal variables

Function blocks use internal variables. For each instance of a function block, labels are assigned to the different areas. Even though the same label names are used, different states are held for each instance.

**Ex.**



The above function block starts counting when the input variables turn on and turns on the output variable when the current value held in the internal variable reaches the set value. Even though the same function block is used, the output timings differ because the instances A and B hold different states.

Internal variables are set in the VAR, VAR\_CONSTANT and VAR\_RETAIN class.

## External variables and public variables

Function blocks can use external variables (global label) and public variables.

Public variables are set in the VAR\_PUBLIC and VAR\_PUBLIC\_RETAIN class.

## Instances

### ■Instances

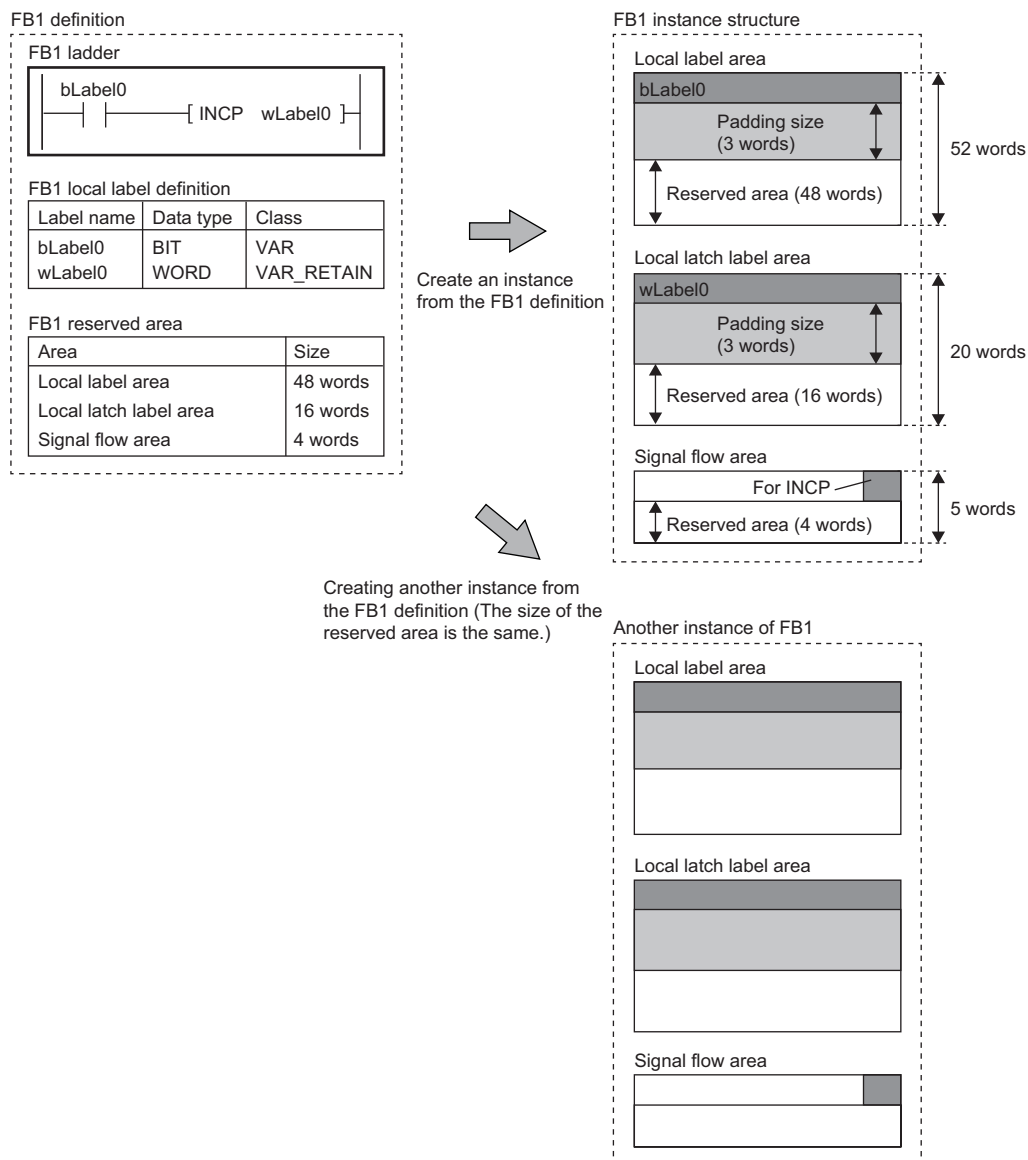
An instance is a label assigned to realize a function block definition. Multiple instances can be created from one function block definition.

An instance consists of the following items.

| Item                   | Description                                                                          |
|------------------------|--------------------------------------------------------------------------------------|
| Local label area       | Used to assign the local label of the function block.                                |
| Local latch label area | Used to assign the latch attribute local label of the function block.                |
| Signal flow area       | Used to assign the signal flow for the instruction in the function block definition. |

**Ex.**

#### Structure of instance



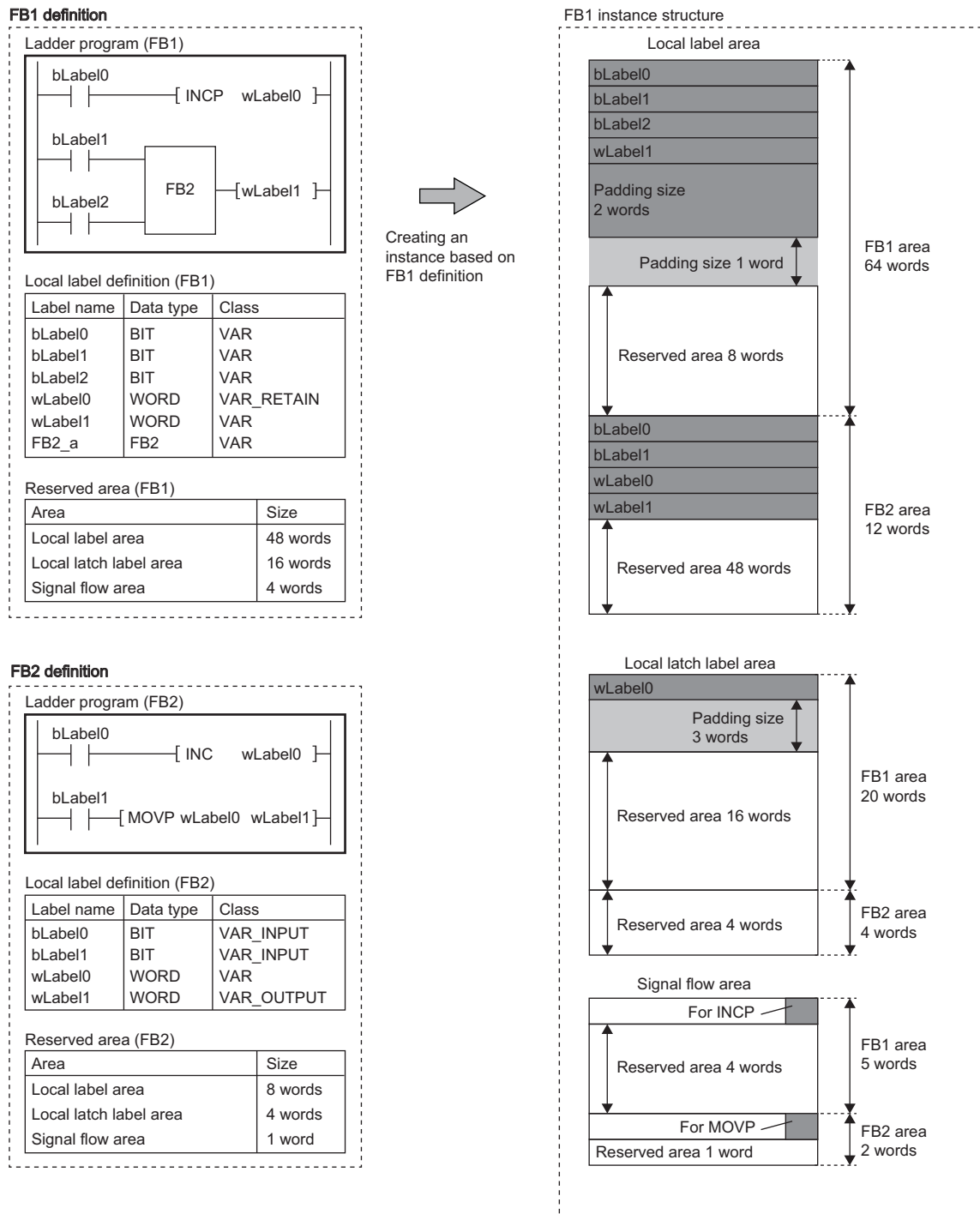
For the local label area and local latch label area, since the label area is secured in units of four words, three-words (padding size) are secured in the above example.

Each area has a reserved area. The reserved area is used to add or change instances of the function block or instructions that refer to local labels or the signal flow memory with the label assignment intact even when the program is converted or changed online.

If the area of the target data type to be added or changed cannot be secured, all programs are required to be converted, or the program is required to be converted and changed online.

**Ex.**

Structure of instance for nested function block (when reserved area of FB2 is changed)



When an FB nests another FB as shown above, the FB instance declared as a local label is secured outside the instance area of the declared source. Also, an area (6 words) for use by the system is secured in the local label area of the declared source. When an FB type local label is added or changed in FB1 of the above figure, the capacity for system use (6 words) is required for the FB1 local label area, and the capacity for the FB2 instance area (capacity for each of the local label area, local latch area, and signal flow area) is required for the instance area of the program that becomes the declared source of FB1. To add or change local labels or FB instances with the assignment intact (without converting all programs), secure the capacity required to add or change them in the reserved area, or convert and change the program online. For the reserved area setting method, refer to the following.

📖 GX Works3 Operating Manual

## ■Creating instances

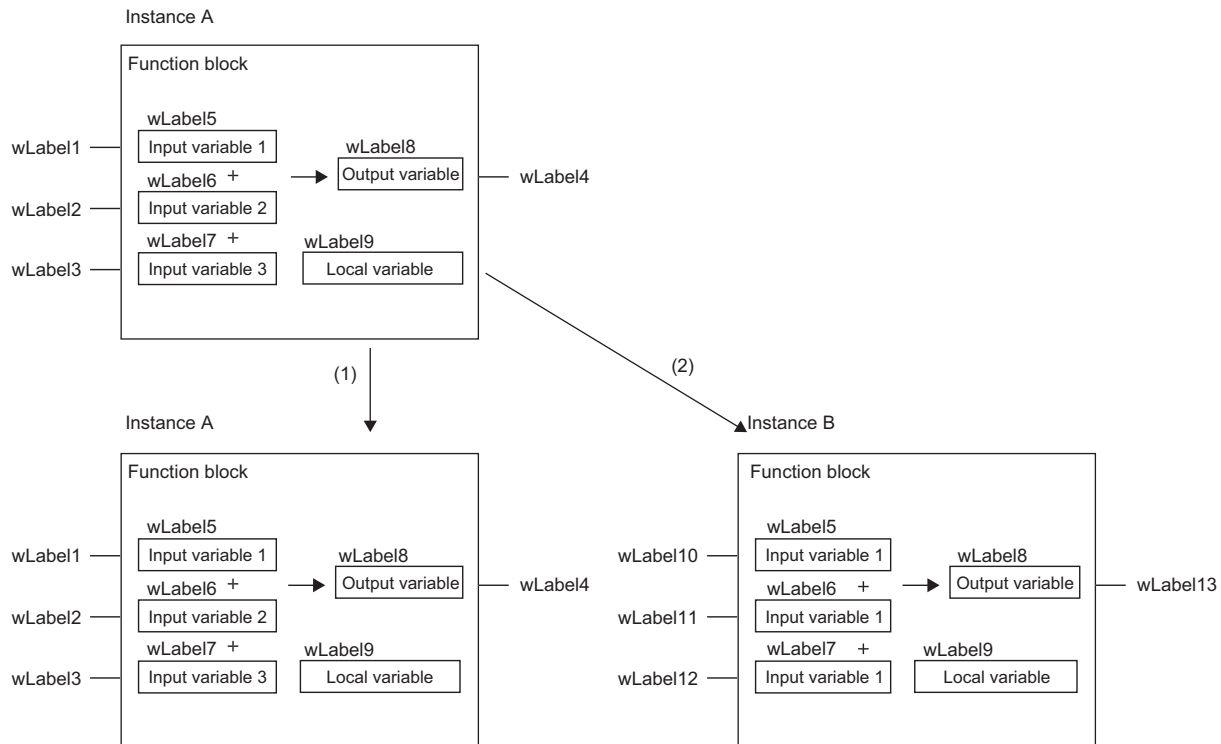
A function block needs to be instantiated to be used in programs.

By creating instances, a function block can be called and executed by a program block or another function block.

Declare instances with global labels or local labels.

| Label type                | Instance type | Class      |
|---------------------------|---------------|------------|
| Global label              | Global FB     | VAR_GLOBAL |
| Local label <sup>*1</sup> | Local FB      | VAR        |

<sup>\*1</sup> Local labels can be declared as the local labels of a program block or function block. Local labels cannot be declared in a function. Same function blocks can be instantiated with different names in a single POU.



(1) Same instances use the same internal variables.

(2) Different instances use different internal variables.

## ■Capacity of instance

The capacity of each data area of an instance should be calculated as follows.

- Capacity of local label area

Capacity of local label area of instance = Total capacity of data of local labels (except the ones with latch attribute) + Capacity of reserved area

| Item                                                            | Description                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Capacity of local labels (except the ones with latch attribute) | Total capacity of the data used for local labels.<br>The capacity of areas to be used differs depending on the memory assignment of labels. For details on memory assignment of labels, refer to the following.<br> GX Works3 Operating Manual |
| Capacity of reserved area                                       | 48 words in default. Set the capacity in units of 4 words.                                                                                                                                                                                                                                                                      |

- Capacity of local latch label area

Capacity of local latch label area of instances = Total capacity of data of local labels with latch attribute + Capacity of reserved area

| Item                                     | Description                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Capacity of latch attribute local labels | Total capacity of the data used for latch attribute local labels.<br>The capacity of areas to be used differs depending on the memory assignment of labels. For details on memory assignment of labels, refer to the following.<br> GX Works3 Operating Manual |
| Capacity of reserved area                | 16 words in default. Set the capacity in units of 4 words.                                                                                                                                                                                                                                                                                      |

- Capacity of signal flow area

Signal flow area capacity of the instance = Total signal flow area used for the instruction in FB definition + Reserved area capacity

| Item                         | Description                                                                                 |
|------------------------------|---------------------------------------------------------------------------------------------|
| Capacity of signal flow area | Total capacity of the signal flow area for the instruction in the function block definition |
| Capacity of reserved area    | 4 words in default. Set the capacity in units of 1 words.                                   |

### Point

Set enough reserved area capacity for the data (such as local labels or the signal flow memory) that is expected to be added or changed when the program is changed online. For the setting method, refer to the following.

 GX Works3 Operating Manual

If some structure labels are included in the local labels of the function block definition, addition or change exceeding the estimated area capacity cannot be made when the program is converted and changed online, and all programs are required to be converted. For more details, check the user's manual for the controller used.

In the following function blocks, the controller memory can be efficiently used by setting smaller value than default to the reserved area.

- Debugged subroutine type function block where no local label is added or changed and no program is changed
- Subroutine type function block that declares many instances

## Setting initial values

### Initial values of local label

For the local label of a function block, an initial value can be set for each function block definition or instance. The local label classes where initial values can be set are VAR, VAR\_RETAIN, VAR\_INPUT, VAR\_OUTPUT, VAR\_OUTPUT\_RETAIN, VAR\_PUBLIC, and VAR\_PUBLIC\_RETAIN.

### Initial values of instance

The following table summarizes the types of the initial values of instances.

| Type                        | Description                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Default initial value       | <p>An initial value predefined for each data type. If an initial value is not set for the local label of a function block, the default initial value will be used.</p> <p>(1) The initial values have not been set for the local labels in the FB1 definition.<br/>(2) The default initial values are used.</p>                                                                       |
| FB definition initial value | <p>An initial value that is set when the local label of a function block is defined. If this initial value has been set, the same definition initial value will be used for all the instances.</p> <p>(1) The initial values have been set for the local labels in the FB1 definition.<br/>(2) All the instances of FB1 will be initialized by the same definition initial value.</p> |
| Instance initial value      | <p>An initial value that is set for an instance included in the global label and program block local label definition.</p> <p>(1) The initial value can be set for each instance in the FB1 definition.</p>                                                                                                                                                                           |

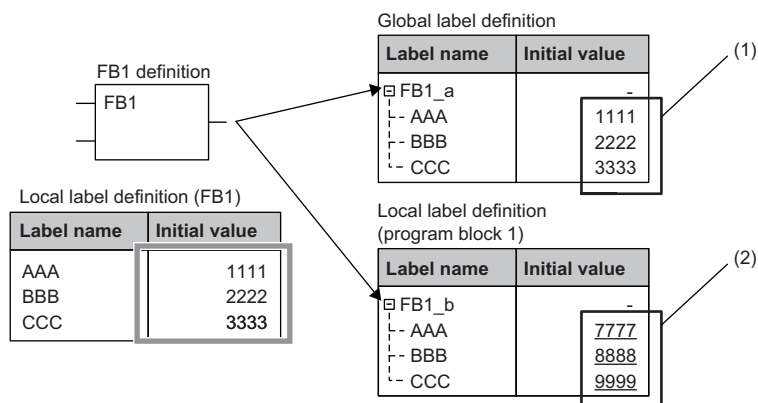
For function blocks, both the FB definition and instance initial values can be set.

If both initial values are set, the initial values used will take the following priority.

| Priority  | Type                        |
|-----------|-----------------------------|
| High<br>↑ | Instance initial value      |
| ↓         | FB definition initial value |
| Low       | Default initial value       |

### Point

If two instances of a function block for which the FB definition initial value has been set are created and the instance initial value is set for only one of them, the FB definition initial value will be used for the instance for which the instance initial value has not been set and the instance initial value will be used for the other.



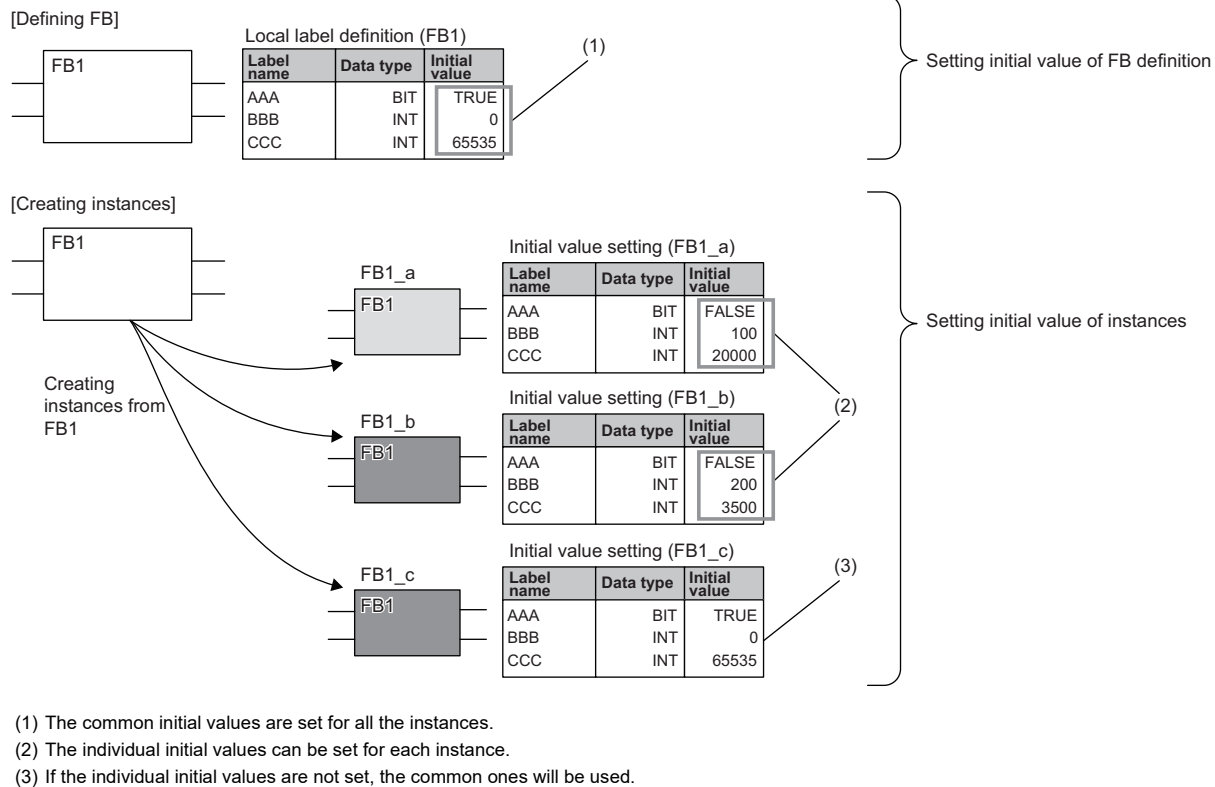
(1) When the instance initial value is not set, the FB definition initial value will be used.

(2) When the instance initial value is set, it will be used.



## ■Example

The following figure shows an example where the function block initial values are used.



## EN and ENO

In the same way as a function, EN (enable input) and ENO (enable output) can also be appended to a function block to control execution processing. (  Page 63 EN and ENO)

When the instance of a function to which EN/ENO has been appended is called, an actual argument must be assigned to EN.



For the execution conditions on the motion control function blocks, refer to the following.

 Page 1431 Execution command (Execute) type/Enable (Enable) type

## Creating programs

The program of a function block can be created by using the engineering tool.

 [Navigation window] ⇒ [FB/FUN] ⇒ Right-click ⇒ [Add New Data]  
Select "Function Block" for "Data Type" in "Basic Setting".

The created program is stored in the FB file.

 [CPU Parameter] ⇒ [Program Setting] ⇒ [FB/FUN File Setting]

Up to 64 created programs can be stored in one FB file.

For details on program creation, refer to the following.

| Item                                                       | Reference                                                                                                               |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| How to create function blocks                              |  IGX Works3 Operating Manual           |
| Number of FB/FUN files that can be written to a controller |  User's manual for the controller used |

### ■Types of program

There are two types of function blocks and the program of each function block type is stored in different ways.

- Subroutine type function block

For details, refer to the following.

 Page 67 Operation overview

The above cannot be selected for module function blocks, standard functions, standard function blocks, and motion control function blocks.

### ■Inherent property setting

The following items can be set when a program of a function block is created. ( IGX Works3 Operating Manual)

| Item                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use MC/MCR to Control EN | For "Yes", the MC/MCR instructions are used to control EN. For "No", the CJ instruction is used to control EN. Select "Yes" when instructions executed at the rising edge or falling edge are used in an FB. The operations of a timer/counter and the OUT instruction used in an FB differ depending on the selected item. For details, refer to the following.<br> Page 85 Operations of when the MC/MCR instructions are used to control EN |
| Use EN/ENO               | For "Yes", a function block with EN/ENO is created, and EN/ENO labels can be used in a program without registering as local labels. For "No", a function block without EN/ENO is created. For details on EN/ENO, refer to the following.<br> Page 75 EN and ENO                                                                                                                                                                                |

### ■Applicable devices and labels

The following table lists the devices and labels that can be used by function block programs.

○: Applicable, △: Applicable only in instructions (Cannot be used to indicate the program step.), ×: Not applicable

| Type of device/label                |                           | Availability |
|-------------------------------------|---------------------------|--------------|
| Label (other than the pointer type) | Global label              | ○            |
|                                     | Local label               | ○            |
| Label (pointer type)                | Pointer type global label | △            |
|                                     | Pointer type local label  | ○            |
| Device                              | Global device             | ○            |
|                                     | Local device              | ×            |
| Pointer                             | Global pointer            | △            |
|                                     | Local pointer             | ×            |

## 2.4 Precautions

### When a function is used

#### Pointer

The local pointer and pointer type global labels cannot be used.

### When a function block is used

#### Pointer

The local pointer cannot be used.

#### When the index register is used

When the index register is used in the function block program, ladder programs for saving and returning the index register values are required to protect the values.

Setting the index register data to 0 when saving can prevent an error that could be caused by an index modification validity check. (Whether the device number exceeds the device range or not is checked.)

#### Ex.

A program that saves the values in the index register Z1 and Z2 before the program execution and returns the saved values after the program execution



Specifying the start I/O number of intelligent function module

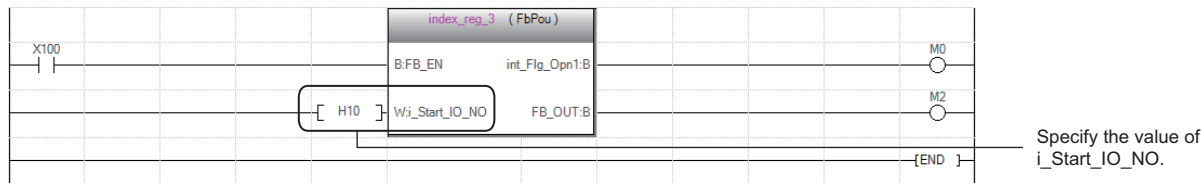
When accessing the buffer memory or I/O signals of the intelligent function module, specify the start I/O number using the index register.

By receiving the start I/O number as an input variable, the same function block can be shared in multiple intelligent function modules without changing the start I/O number.

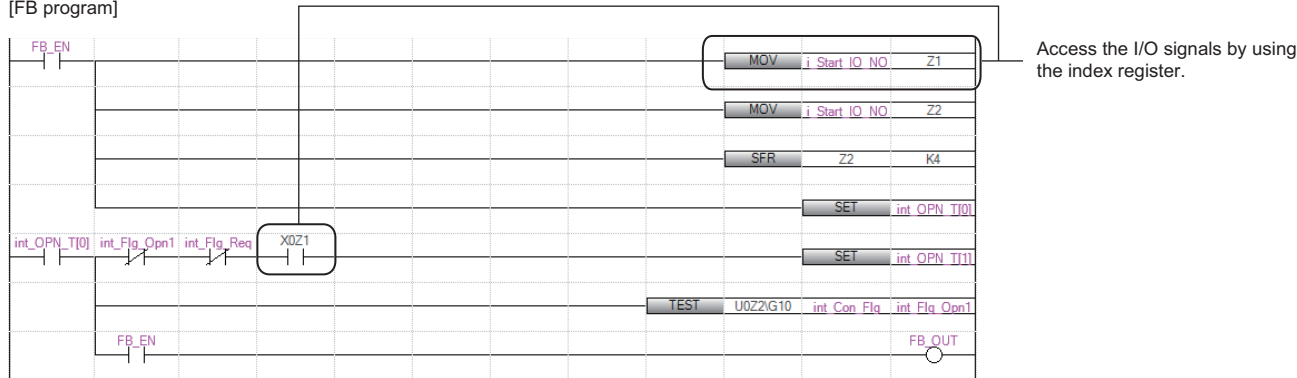
Ex.

To access the I/O signals of the intelligent function module  
Use the index register.

[Sequence program]



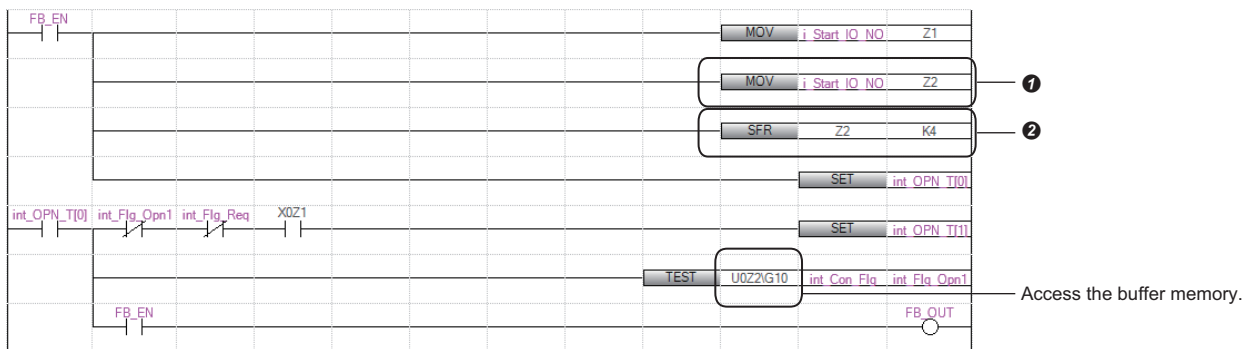
[FB program]



Ex.

To access the buffer memory of the intelligent function module

- 1 Input the start I/O number of the target intelligent function module in the index register.
- 2 Shift the four bits in the value to the right by using the SFR instruction, or use the quotient obtained by dividing the value by 16.



## Copying a macro type function block

When using multiple macro type function blocks, drag and drop them from the Element Selection window.

When the FB compilation method copies a macro type function block on the program editor, the copied function block is changed to a subroutine type function block.

When copying a module FB or FB library, check the reference manual of the function block to be used, and check whether the FB compilation method indicates subroutine type before using it.

### Point

A macro type function block is a type of function block used in a module FB or FB library. It cannot be defined by users.

The program is loaded by a calling source program along the execution flow. At the time of program execution, the loaded program is executed in the same way as the main program.

## Calling a macro type function block

Call each instance of a macro type function block as a pointer destination by using a pointer type label only once in a project. If the same instance of a macro type function block as a pointer destination using a pointer type label is called multiple times, a conversion error occurs.

## Restrictions for module function blocks

The following describes the restrictions for the use of module function blocks.

- Do not turn off the contact of the MC instruction when calling a module function block between the MC instruction and MCR instruction.
- Do not perform the jump processing that prevents module function blocks from being called by the CJ instruction, SCJ instruction, and JMP instruction.
- Execute a subroutine program every scan when calling a module function block in the subroutine program. Do not perform the non-execution processing of a subroutine program by using the FCALL(P) instruction, EFCALL(P) instruction, or XCALL instruction.
- Do not call a module function block in an interrupt program, an initial execution type program, a fixed scan execution type program, or an event execution type program.
- Do not call a module function block between the FOR and NEXT instructions, in the inline ST, or the control syntax of the structured text language (IF statement, FOR statement, and CASE statement.)
- Specifying modified devices for input and output arguments of some module FBs may cause an error. To specify modified devices for input and output arguments of a module FB, describe a processing so that the value is transferred after the module FB is called.

## Changing operating parameters of module function blocks

Operating parameters (external variables) other than input and output labels of module function blocks can be changed on the label setting window by using the engineering tool.

- When the instance of a module function block is set to local label, change the parameters on the "Local Label Setting" window.

🔗 [Navigation Window] ⇒ [Program] ⇒ execution type ⇒ program file ⇒ program block ⇒ [Local Label]

- When the instance of a module function block is set to global label, change the parameters on the "Global Label Setting" window.

🔗 [Navigation Window] ⇒ [Label] ⇒ [Global Label]

**Ex.**

Local Label Setting window

| Label Name                             | Data Type                             | Comment |
|----------------------------------------|---------------------------------------|---------|
| 1 M_RCPU_Maynchronization_Delay1OUT_00 | M+RCPU_Maynchronization_Delay1OUT_00A |         |
| 2 M_RJ71GF11_DeviceRead_00B_1          | M+RJ71GF11_DeviceRead_00B             |         |
| 3                                      |                                       |         |

| Class      | Label Name           | Data Type                                  | Initial Value | Comment |
|------------|----------------------|--------------------------------------------|---------------|---------|
| VAR_INPUT  | i_bEN                | Bit                                        |               |         |
| VAR_INPUT  | i_stModule           | M+RJ71GF11                                 |               |         |
| VAR_INPUT  | i_u2TargetAddress    | Word [Unsigned]/Bit String [16-bit][0..1]  |               |         |
| VAR_INPUT  | i_uDataLength        | Word [Unsigned]/Bit String [16-bit]        |               |         |
| VAR_INPUT  | i_s32TargetDevice    | String(32)                                 |               |         |
| VAR_INPUT  | i_uChannel           | Word [Unsigned]/Bit String [16-bit]        |               |         |
| VAR_OUTPUT | o_bENO               | Bit                                        |               |         |
| VAR_OUTPUT | o_bOK                | Bit                                        |               |         |
| VAR_OUTPUT | o_bErr               | Bit                                        |               |         |
| VAR_OUTPUT | o_uErrId             | Word [Unsigned]/Bit String [16-bit]        |               |         |
| VAR_OUTPUT | o_uReadData          | Word [Unsigned]/Bit String [16-bit]        |               |         |
| VAR_PUBLIC | pbl_uCPU_Type        | Word [Unsigned]/Bit String [16-bit]        |               |         |
| VAR_PUBLIC | pbl_uResendCountMax  | Word [Unsigned]/Bit String [16-bit]        |               |         |
| VAR_PUBLIC | pbl_uTimeUnit        | Word [Unsigned]/Bit String [16-bit]        |               |         |
| VAR_PUBLIC | pbl_uMonitorTime     | Word [Unsigned]/Bit String [16-bit]        |               |         |
| VAR_PUBLIC | pbl_bStationSpecific | Bit                                        |               |         |
| VAR_PUBLIC | pbo_uResendCount     | Word [Unsigned]/Bit String [16-bit]        |               |         |
| VAR_PUBLIC | pbo_uErrTime         | Word [Unsigned]/Bit String [16-bit][0..3]  |               |         |
| VAR_PUBLIC | pbo_uErrNetworkNo    | Word [Unsigned]/Bit String [16-bit]        |               |         |
| VAR_PUBLIC | pbo_uErrStationNo    | Word [Unsigned]/Bit String [16-bit]        |               |         |
| VAR        | u18ControlData       | Word [Unsigned]/Bit String [16-bit][0..17] |               |         |
| VAR        | b_Start              | Bit                                        |               |         |
| VAR        | b2Comp               | Bit(0..1)                                  |               |         |

Set operating parameters in the "Initial Value" field.

## Operations of when the MC/MCR instructions are used to control EN

The following table lists operations of instructions, devices, and labels used in a function block when "Use MC/MCR to Control EN" is enabled in the inherent property setting of the function block.

| Instruction/device/label used in a function block                                                                         | Operation of Instruction/device/label used in a function block                                         |                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
|                                                                                                                           | When "Yes" is selected for "Use MC/MCR to Control EN"                                                  | When "No" is selected for "Use MC/MCR to Control EN"                                                          |
| Instructions executed at the rising edge or falling edge (PLS, instructions for conversion to pulses (□P) <sup>*1</sup> ) | The next time EN is turned on, the instruction is executed if the condition contact is TRUE.           | The next time EN is turned on, the instruction may not be executed even though the condition contact is TRUE. |
| Timer (low-speed/high-speed), long timer                                                                                  | The count value becomes 0 and the both coil and contact turn off.                                      | The state of devices remains unchanged.                                                                       |
| Retentive timer (low-speed/high-speed), long retentive timer, counter, long counter                                       | The coil turns off, but the current count value and the current state of the contact remain unchanged. | The state of devices remains unchanged.                                                                       |
| Devices specified as the device part of the OUT instruction                                                               | The devices are forcibly turned off.                                                                   | The state of devices remains unchanged.                                                                       |

\*1 Instructions specified in the coil side apply.

### Restriction

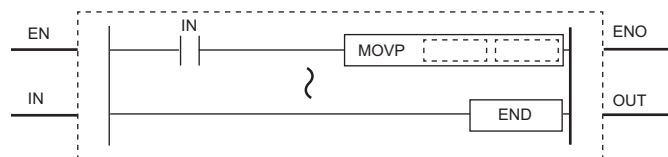
When "Yes" is selected for "Use MC/MCR to Control EN", do not use the MC/MCR instructions while the function block is being executed. If the MC/MCR instructions are used, the EN control may not operate properly.

## Instructions executed at the rising/falling edge

The following describes operations of instructions executed at the rising/falling edge.

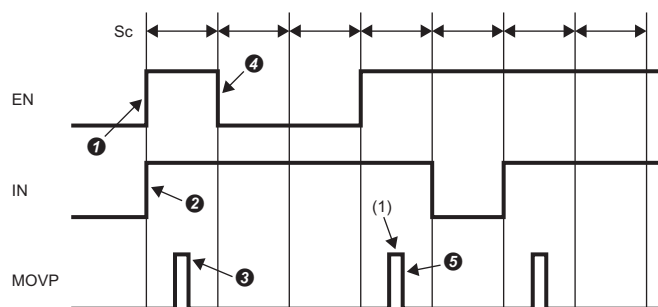
**Ex.**

A subroutine-type FB using an instruction executed at the rising edge



### ■When "Yes" is selected for "Use MC/MCR to Control EN"

When EN is turned on, the instruction is executed if the condition contact is TRUE ((1) in the following figure).

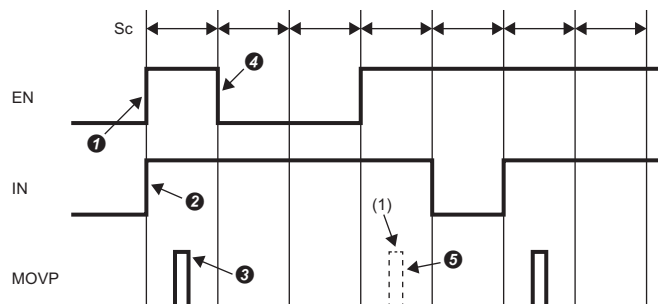


Sc: Scan

- ① EN is turned on. (User operation)
- ② IN is turned on. (User operation)
- ③ The MOV instruction is executed. (Controller operation)
- ④ EN is turned off. (User operation)
- ⑤ The MOV instruction is executed. (Controller operation)

### ■When "No" is selected for "Use MC/MCR to Control EN"

When EN is turned off, operations of the instruction differ depending on the condition contact status ((1) in the following figure).



Sc: Scan

- ① EN is turned on. (User operation)
- ② IN is turned on. (User operation)
- ③ The MOV instruction is executed. (Controller operation)
- ④ EN is turned off. (User operation)
- ⑤ The MOV instruction is executed when the condition contact is FALSE immediately before EN is turned off at ④. (Controller operation) (The MOV instruction is not executed when the condition contact is TRUE immediately before EN is turned off at ④.)

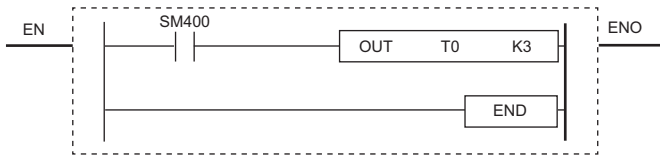


## Timer (low-speed/high-speed) and long timer

The following describes operations of the timer (low-speed/high-speed) and long timer.

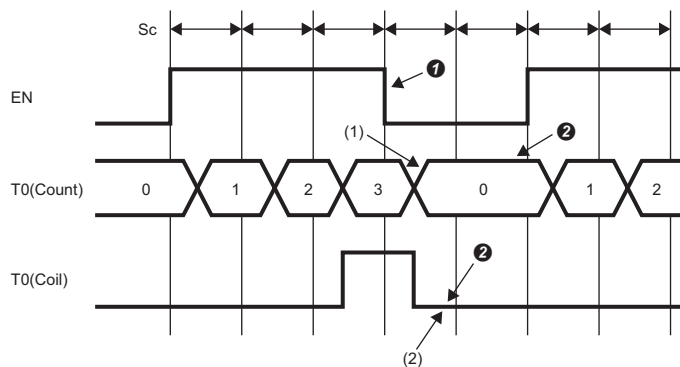
### Ex.

A subroutine-type FB using a low-speed timer



### ■When "Yes" is selected for "Use MC/MCR to Control EN"

The count value becomes 0 ((1) in the following figure). The coil turns off ((2) in the following figure).



Sc: Scan

T0(Count): T0 (count value)

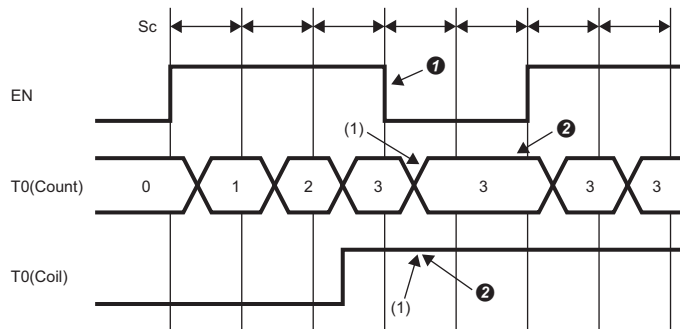
T0(Coil): T0 (coil)

① EN is turned off. (User operation)

② The coil turns off and the timer value and the count value are cleared. (Controller operation)

### ■When "No" is selected for "Use MC/MCR to Control EN"

The current count value and the current state of the coil remain unchanged. ((1) in the following figure).



Sc: Scan

T0(Count): T0 (count value)

T0(Coil): T0 (coil)

① EN is turned off. (User operation)

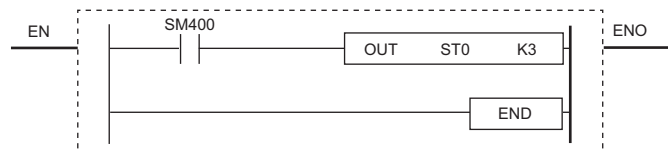
② The values remain unchanged. (Controller operation)

## Retentive timer (low-/high-speed), long retentive timer, counter, and long counter

The following describes operations of the retentive timer (low-speed/high-speed), long retentive timer, counter, and long counter.

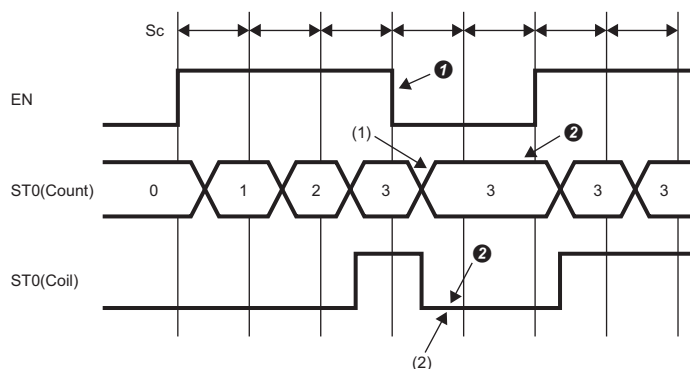
**Ex.**

A subroutine-type FB using a low-speed retentive timer



### ■When "Yes" is selected for "Use MC/MCR to Control EN"

The current count value remain unchanged. ((1) in the following figure). The coil turns off ((2) in the following figure).



Sc: Scan

ST0(Count): T0 (count value)

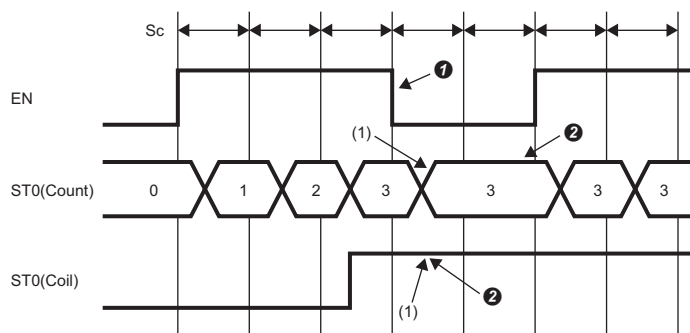
ST0(Coil): T0 (coil)

① EN is turned off. (User operation)

② The coil turns off, but the current count value and the current state of the contact remain unchanged. (Controller operation)

### ■When "No" is selected for "Use MC/MCR to Control EN"

The current count value and the current state of the coil remain unchanged. ((1) in the following figure).



Sc: Scan

ST0(Count): T0 (count value)

ST0(Coil): T0 (coil)

① EN is turned off. (User operation)

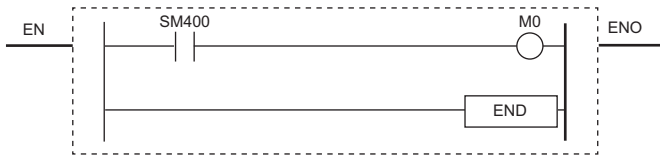
② The values remain unchanged. (Controller operation)

## Devices specified as the device part of the OUT instruction

The following describes operations of devices specified as the device part of the OUT instruction.

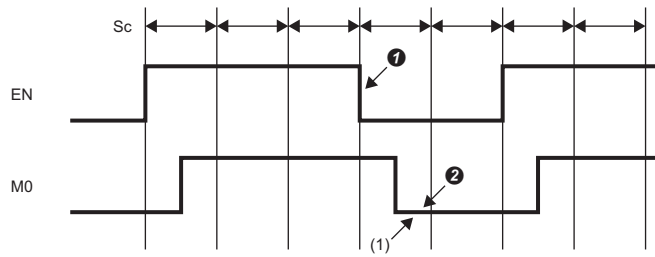
**Ex.**

A subroutine-type FB using M0 for the device part of the OUT instruction.



### ■When "Yes" is selected for "Use MC/MCR to Control EN"

M0 is forcibly turned off ((1) in the following figure).



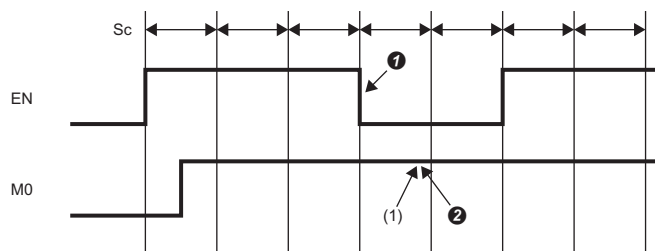
Sc: Scan

① EN is turned off. (User operation)

② The coil turns off. (Controller operation)

### ■When "No" is selected for "Use MC/MCR to Control EN"

The current state of M0 remains unchanged ((1) in the following figure).



Sc: Scan

① EN is turned off. (User operation)

② The state of coil remains unchanged. (Controller operation)

# 3 LADDER DIAGRAM

Ladder diagram is a programming language used to describe sequence control. Each ladder consists of contacts and coils and represents logical operations consisting of AND/OR in combinations of series and parallel.

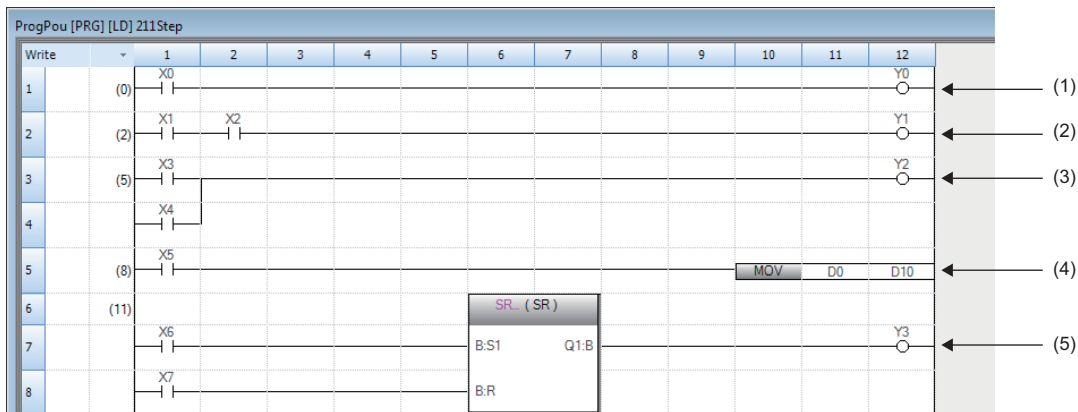


This chapter describes the operation and specifications of the ladder diagram. For the operation method of the engineering tool for creating a ladder program, refer to the following.

GX Works3 Operating Manual

## 3.1 Configuration

The following are the programs written in ladder diagram.

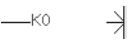
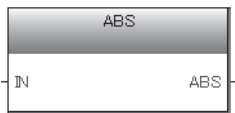
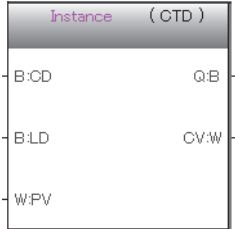


- (1) Ladder program consisting of a contact and a coil
- (2) Ladder program configured in series
- (3) Ladder program configured in parallel
- (4) Ladder program using an instruction
- (5) Ladder program using a standard function/function block

## Ladder symbols

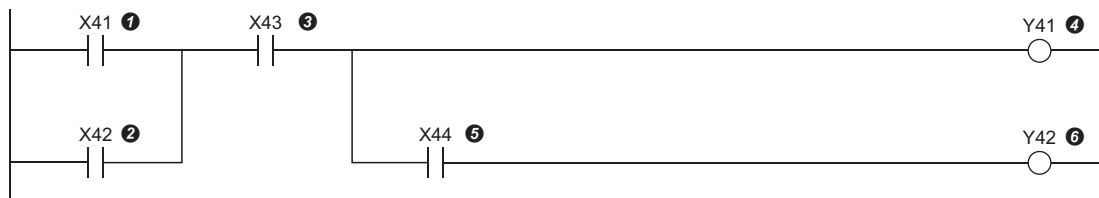
The following table lists the ladder symbols that can be used for programming in ladder diagram.

| Item                                          |  | Description                                                                                                                          |
|-----------------------------------------------|--|--------------------------------------------------------------------------------------------------------------------------------------|
| Normally open contact                         |  | Energized when the specified device or label is on.                                                                                  |
| Normally closed contact                       |  | Energized when the specified device or label is off.                                                                                 |
| Rising edge pulse                             |  | Energized on the rising edge (off to on) of the specified device or label.                                                           |
| Falling edge pulse                            |  | Energized on the falling edge (on to off) of the specified device or label.                                                          |
| Negated rising edge pulse                     |  | Energized when the specified device or label is off, on, or on the falling edge (on to off).                                         |
| Negated falling edge pulse                    |  | Energized when the specified device or label is off, on, or on the rising edge (off to on).                                          |
| Operation result rising edge pulse conversion |  | Energized on the rising edge (off to on) of the operation result. De-energized while the operation result is not on the rising edge. |

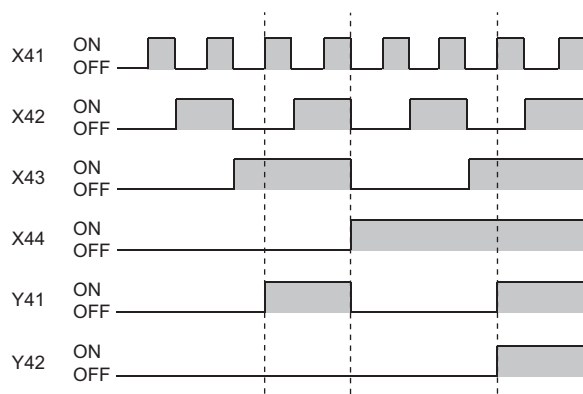
| Item                                           |                                                                                    | Description                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operation result falling edge pulse conversion |   | Energized on the falling edge (on to off) of the operation result. De-energized while the operation result is not on the falling edge.                                                                                                                                                                                                                                                   |
| Operation result inversion                     |   | Inverts the previous operation results.                                                                                                                                                                                                                                                                                                                                                  |
| Coil                                           |   | Outputs the operation result to the specified device or label.                                                                                                                                                                                                                                                                                                                           |
| Instruction                                    |   | Executes the instruction specified in "[ ]".                                                                                                                                                                                                                                                                                                                                             |
| Loopback                                       |   | When the number of contacts that can be created on a single ladder line is exceeded, the ladder is looped back with loopback source and destination symbols created on it.                                                                                                                                                                                                               |
| Function                                       |   | Executes a function. <ul style="list-style-type: none"> <li>• How to create functions (GX Works3 Operating Manual)</li> <li>• Standard function (Page 183 Standard Functions)</li> </ul>                                                                                                                                                                                                 |
| Function block                                 |  | Executes a function block. <ul style="list-style-type: none"> <li>• How to create function blocks (GX Works3 Operating Manual)</li> <li>• Standard function block (Page 194 Standard Function Blocks)</li> <li>• Motion control function block (Page 196 MOTION CONTROL FUNCTION BLOCK LIST)</li> <li>• Module function blocks (Function Block Reference for the module used)</li> </ul> |

## Program execution order

The program is executed in order of the following numbers.



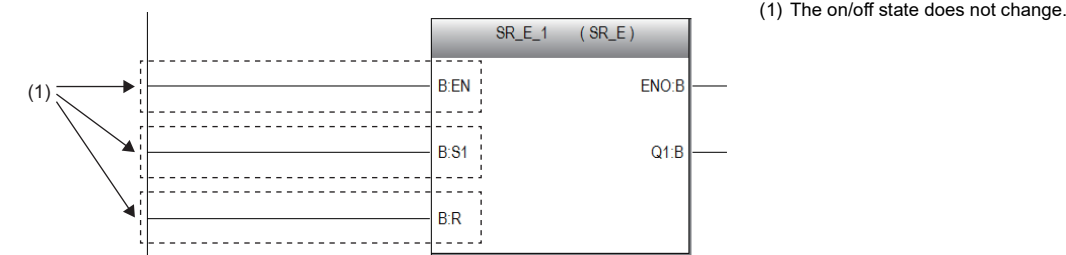
When the above program is executed, Y41 and Y42 turn on while X41 to X44 turn on or off as shown below.



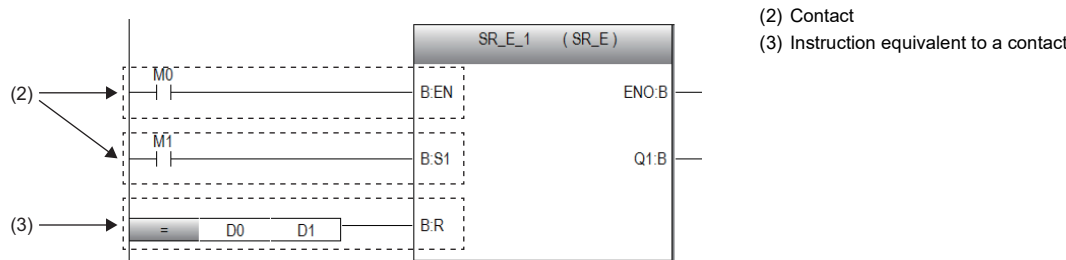
# Precautions for using a function block in ladder diagram

## Precautions for directly connecting to an FB instance from the left rail

When EN and input variables (bit type) are directly connected to the left rail in the input circuit of the FB instance, the on/off state does not change.



To change the on/off states of EN and the input variables (bit type), use a contact or an instruction equivalent to the contact.

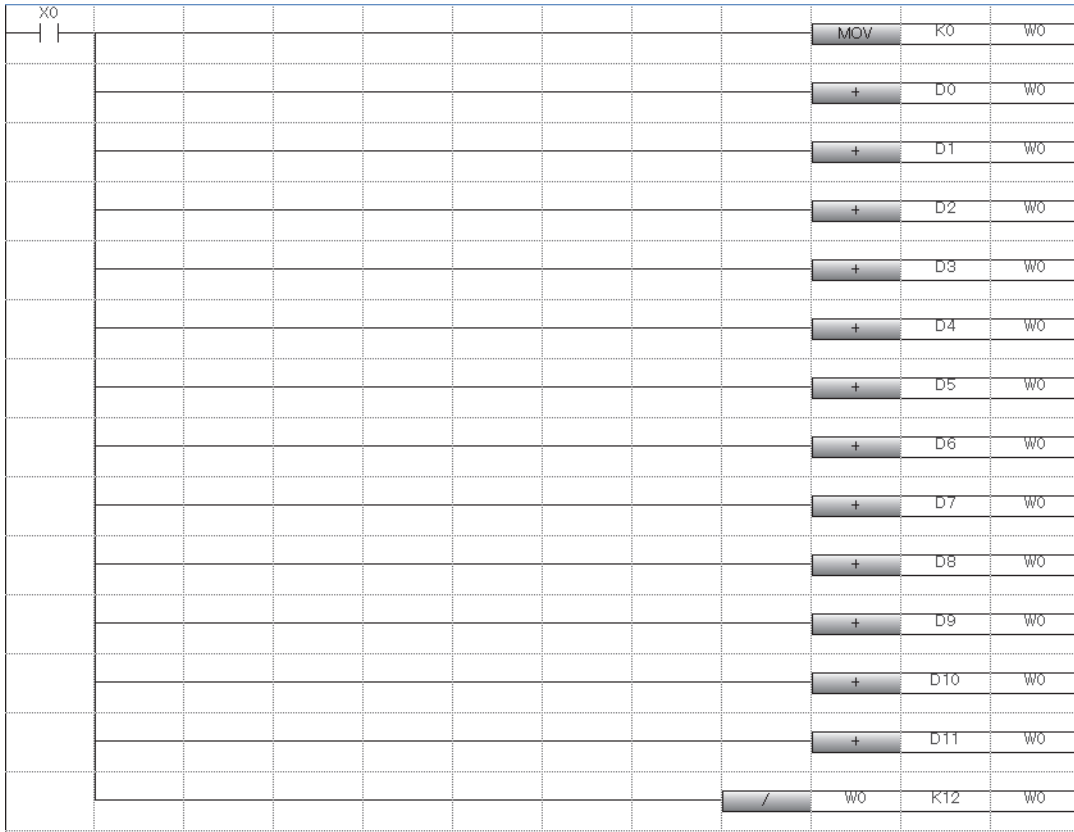


## 3.2 Inline ST

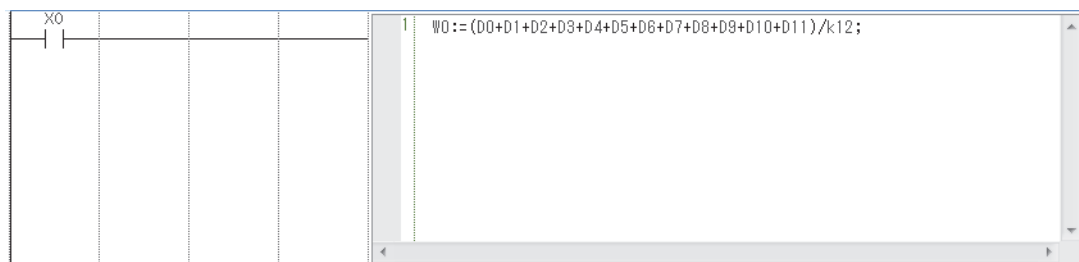
The inline ST is the function used to create an inline ST box that displays an ST program in the cell of the instruction corresponding to a coil in the ladder editor, and edit and monitor it.

This function enables to create numerical operations and string processing easily in ladder programs.

- Program that does not use the inline ST



- Program that uses the inline ST



## Specifications

For the specifications of the ST program described to the inline ST, refer to the specifications of the ST language.

Page 92 STRUCTURED TEXT LANGUAGE

## Precautions

- Only one inline ST can be created on a single line of a ladder program.
- Both a function/function block and inline ST box cannot be used on a single line of a ladder program.
- Creating an inline ST box at the position of an instruction corresponding to a contact creates an inline ST box at the position of an instruction corresponding to a coil.
- Up to 20000 characters can be input in the inline ST. (A newline is counted as two characters.)
- Using a RETURN statement in the inline ST causes the processing in the inline ST box to end, instead of the processing of the program block.
- When the inline ST in the program of a function is used, no function block can be called from the inline ST.
- The inline ST uses the CJ instruction in conversion to control the operation of a program. When the contact of the inline ST is off, the processing in the inline ST is not executed by the CJ instruction. Thus, for example, the device that turned on by the assignment statement in the inline ST holds its output status even when the inline ST is not executed. For details on the CJ instruction, refer to the following.

 Page 534 CJ, SCJ, JMP

- In the inline ST, OUT, OUTH, or other instructions which refer to the previous execution status of the signal flow memory cannot be used.

 User's manual for the controller used



## 3.3 Statements and Notes

Statements and notes can be used in ladder programs.

### Statements

A statement is used to add a comment to a ladder block. Adding a comment makes it easy to understand the flow of processing.

There are three types of statements: line statement, P statement, and I statement.

The line statement can be displayed in the tree of the navigation window.

#### ■Line statement

This type of statement adds a comment to the entire ladder block.

#### ■P statement

This type of statement adds a comment to a pointer device.

#### ■I statement

This type of statement adds a comment to an interrupt pointer device.

### Notes

A note is used to add a comment to a coil and instruction in a program.

Adding a comment makes it easy to understand the contents of the coil and instruction.

### Categories of statements and notes

Statements and notes are classified into two categories: "In PLC" and "In Peripheral".

| Category      | Type                                                                                                                        | Description                                                                                                                                                                                                                       |
|---------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| In PLC        | <ul style="list-style-type: none"><li>• Line statement</li><li>• P statement</li><li>• I statement</li><li>• Note</li></ul> | Strings of the description are not embedded in the program during conversion, but they are saved as attached information of the program.<br>One line uses one step.                                                               |
| In Peripheral | <ul style="list-style-type: none"><li>• Line statement</li><li>• P statement</li><li>• I statement</li><li>• Note</li></ul> | Strings of the description are not embedded in the program, but they are saved as attached information of the program.<br>One line uses one step.<br>A text that has been entered is automatically preceded by an asterisk "***". |

# 4

## STRUCTURED TEXT LANGUAGE

ST language is defined by International Standard IEC 61131-3 that defines the logic description system. ST language is a text language with a similar grammatical structure to C. This language is suitable for programming complicated processing that cannot be easily described by ladder diagram.

### Point

This chapter describes the operation and specifications of the structured text language. For the operation method of the engineering tool for creating an ST program, refer to the following.

 GX Works3 Operating Manual

The ST language supports control syntax, operational expressions, function blocks (FB), and functions (FUN), and can describe them as shown below.

### Ex.

Control syntax such as selective branches by conditional statements and iteration statements

(\*Control conveyors, Line A to C.\*)

```
CASE Line OF
  1:
    Start_switch := TRUE; (*The conveyor starts.*)
  2:
    Start_switch := FALSE; (*The conveyor stops.*)
  3:
    Start_switch := TRUE; (*The conveyor stops with an alarm.*)
ELSE
  Alarm_lamp := TRUE;
END_CASE;
IF Start_switch = TRUE THEN (*The conveyor starts and performs processing 100 times.*)
  FOR Count := 0 TO 100 BY 1 DO
    Count_No. := Count_No + 1;
  END_FOR;
END_IF;
```

### Ex.

Expression using operators (\*, /, +, -, <, >, =)

```
D0 := D1 * D2 + D3 / D4 - D5 ;
IF D0 > D10 THEN
  D0 := D10;
END_IF;
```

### Ex.

Calling function blocks that have been defined

```
//FB data name: LINE1_FB
//Input variable: I_Test
//Output variable: O_Test
//Input/output variable: IO_Test
//FB label name: FB1
FB1(I_Test:= D0 , O_Test => D1 ,IO_Test:= D100 );
```

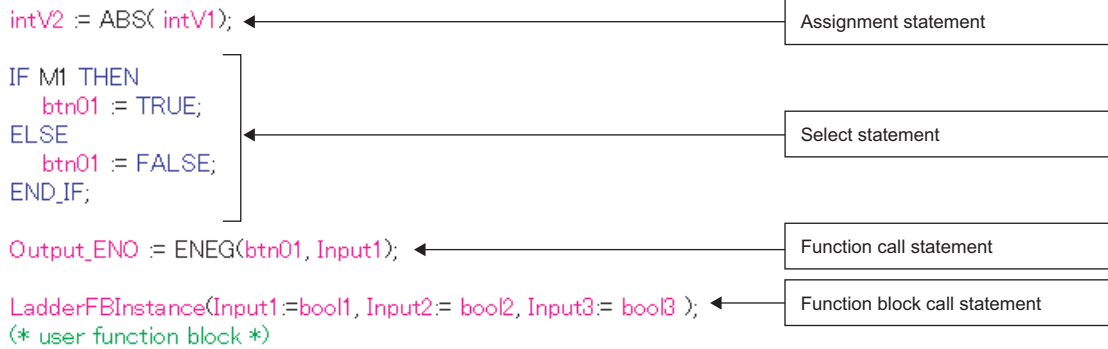
### Ex.

Calling standard functions

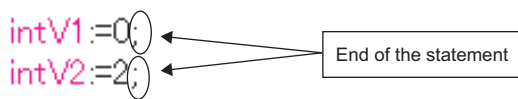
```
(*Convert BOOL data type to INT/DINT data type.*)
wLabel2 := BOOL_TO_INT (bLabel1);
```

# 4.1 Configuration

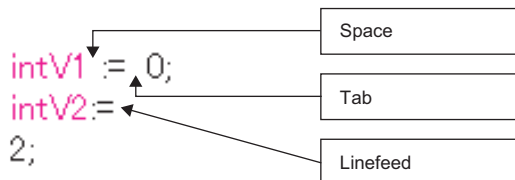
Programs written in ST language consist of operators and control statements.



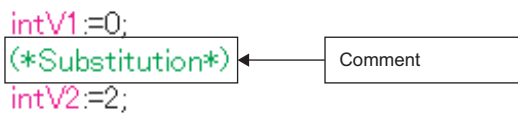
Each statement must end with a semicolon ";".



Spaces, tabs, and line feeds can be inserted between an operator and data.



Comments can be inserted into a program. Enclose a comment statement with "(\*" and "\*)".



## Program components

An ST program consists of the following components.

| Item          | Example                                  | Reference                   |
|---------------|------------------------------------------|-----------------------------|
| Delimiter     | ;, (, )                                  | Page 94 Delimiter           |
| Operator      | +, -, <, >, =                            | Page 94 Operators           |
| Reserved word | Control statement                        | IF, CASE, WHILE, RETURN     |
|               | Device                                   | X40, Y50, M100, ZR0         |
|               | Data type                                | BOOL, DWORD                 |
|               | Standard function                        | ADD, REAL_TO_STRING_E       |
| Constant      | 123, "abc"                               | Page 106 Constants          |
| Label         | Switch_A                                 | Page 107 Labels and devices |
| Comment       | (*Turn on.*)                             | Page 109 Comments           |
| Other symbols | One-byte space, line feed code, TAB code | —                           |

- Write delimiters, operators, and reserved words in one-byte characters.
- For details on the reserved words, refer to the following.

GX Works3 Operating Manual

# Delimiter

ST language supports the following delimiters to make the program structure clear.

| Symbol                    | Description                                          |
|---------------------------|------------------------------------------------------|
| ()                        | Parenthesized expression                             |
| []                        | Specification of array element number                |
| . (period)                | Specification of structure or function block members |
| , (comma)                 | Argument separation                                  |
| : (colon)                 | Device type specifier or CASE statement delimiter    |
| ; (semicolon)             | Termination of statement                             |
| " (double quotation mark) | Notation of Unicode string                           |
| ' (single quotation mark) | Notation of string (ASCII, Shift JIS)                |
| .. (two periods)          | Specification of integer range                       |

# Operators

The following table lists the operators, applicable data types, and operation result data types used in ST programs.

| Operator             | Applicable data type                                | Operation result type |
|----------------------|-----------------------------------------------------|-----------------------|
| *, /, +, -           | ANY_NUM <sup>*1</sup>                               | ANY_NUM               |
| <, >, <=, >=, =, <>  | ANY_ELEMENTARY <sup>*2</sup>                        | Bit                   |
| MOD                  | ANY_INT                                             | ANY_INT               |
| AND, &, XOR, OR, NOT | ANY_BIT                                             | ANY_BIT               |
| **                   | ANY_REAL (base)<br>ANY_NUM (exponent) <sup>*1</sup> | ANY_REAL              |

\*1 Notation of constants with "WORD#" or "DWORD#" cannot be specified. (Page 106 Notation of constants)

\*2 WSTRING data type Unicode string cannot be specified.

The following table lists the operators in descending order of priority.

| Operator     | Description              | Example           | Priority |
|--------------|--------------------------|-------------------|----------|
| ()           | Parenthesized expression | (2+3)*(4+5)       | 1        |
| Function ()  | Function call expression | CONCAT('AB','CD') | 2        |
| -            | Sign inversion           | -10               | 3        |
| NOT          | Bit type complement      | NOT TRUE          |          |
| **           | Exponentiation           | 3.0**4            | 4        |
| *            | Multiplication           | 10*20             | 5        |
| /            | Division                 | 20/10             |          |
| MOD          | Remainder                | 17 MOD 10         |          |
| +            | Addition                 | 1.4+2.5           | 6        |
| -            | Subtraction              | 3-2               |          |
| <, >, <=, >= | Comparison               | 10>20             | 7        |
| =            | Equality                 | T#26h=T#1d2h      | 8        |
| <>           | Inequality               | 8#15<>13          |          |
| &, AND       | AND operation            | TRUE AND FALSE    | 9        |
| XOR          | XOR operation            | TRUE XOR FALSE    | 10       |
| OR           | OR operation             | TRUE OR FALSE     | 11       |

- If one expression includes multiple operators with the same priority, operation is performed in order from the leftmost operator.
- Up to 1024 operators can be used in a single expression.

# Instruction

This section describes instructions used in the ST program.



```
bResult := BMOV( TRUE, wValue0, 1, wValue1);
```

(1) Specify a return value.

(The example shown above indicates that ENO is assigned to bResult. For instructions, the description of the return value can be omitted.)

(2) Specify an instruction name.

(3) Specify instruction arguments.

## Omitting the specification of arguments in EN for instructions

For instructions, the specification of arguments in EN can be omitted.

In that case, the following program can be described as operation is performed assuming that TRUE is assigned to EN.

```
//Before omission
MOV(TRUE, SrcLabel, DstLabel);
//After omission
MOV(SrcLabel, DstLabel);
```

For cases other than instructions (such as standard functions), EN cannot be omitted.

# Control statements

The following table lists the control statements that can be used in ST programs.

| Item                         | Description                                 | Reference                             |
|------------------------------|---------------------------------------------|---------------------------------------|
| Assignment statement         | Assignment statement                        | Page 96 Assignment statement          |
| Subprogram control statement | Function block and function call statements | Page 98 Subprogram control statements |
|                              | RETURN statement                            |                                       |
| Select statement             | IF statement (IF THEN, IF ELSE, IF ELSIF)   | Page 99 Select statements             |
|                              | CASE statement                              |                                       |
| Iteration statement          | FOR statement                               | Page 99 Iteration statements          |
|                              | WHILE statement                             |                                       |
|                              | REPEAT statement                            |                                       |
|                              | EXIT statement                              |                                       |

Write control statements in one-byte characters.

## Assignment statement

| Format                     | Description                                                                                                                                                                                                 | Example                |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <Left side>:=<Right side>; | This statement assigns the result of the right side expression to the label or device on the left side.<br>The data types of the result of the right side expression and the left side need to be the same. | intV1:=0;<br>intV2:=2; |

When using an array type label and structure label, note the data types of the left side and right side of the assignment statement.

For array type labels, the data type and the number of elements need to be the same between the left and right sides. When using array type labels, do not specify elements.

**Ex.**

intAry1:=intAry2;

For structure labels, the data type of the structure needs to be the same between the left and right sides.

**Ex.**

dutVar1:=dutVar2;

When the right side is the function call expression, the return value of the function is assigned to the left side. The following table lists examples to assign the return value to the label.

| Function                                            | Example                                                                                                                                  |
|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Having one input variable (example: ABS)            | Output1 := ABS( Input1 );                                                                                                                |
| Having three input variables (example: MAX)         | Output1 := MAX( Input1 , Input2 , Input3 );                                                                                              |
| Having EN/ENO (standard functions) (example: MAX_E) | Output1 := MAX_E( boolEN , boolENO , Input1 , Input2 , Input3 );                                                                         |
| Except for standard functions (example: MOV)        | boolENO := MOV( boolEN , Input1 , Output1 );<br>(The execution result of the function is ENO, and the first argument (variable1) is EN.) |

## ■ Automatic conversion of data type

When assignment or arithmetic operational expressions between different data types is described in ST language, one data type may be converted automatically.

### Ex.

Example of automatic conversion

```
dintLabel1 := intLabel1;
// Assignment statement: Automatically convert the INT type variable (intLabel1) to a DINT type variable, and assign it to the DINT type variable (dintLabel1).

dintLabel1 := dintLabel2 + intLabel1;
// Arithmetic operational expression: Automatically convert the INT type variable (intLabel1) to a DINT type variable, and perform addition in DINT type.

DMOV(TRUE, wordLabel1, dwordLabel1);
// Instruction, function, and function block call statement: Automatically convert the WORD type input argument (wordLabel1) to a DWORD type variable, and transfer the data.
```

Type conversion is performed in assignment statements, VAR\_INPUT part where input argument is passed to function blocks and functions (including instruction, standard functions, and standard function blocks), and arithmetic operational expressions.

To prevent data from being lost during type conversion, conversion is performed only from a smaller size data type to a larger size data type. Type conversion is performed for the following data types among the primitive data types.

| Data type                                   | Description                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Word [signed]                               | When the data type is converted to the double word [signed], the value is automatically sign extended.<br>When the data type is converted to the single-precision real number or double-precision real number, the value is automatically converted to the same value as the integer before conversion.*1                                                  |
| Word [unsigned]/bit string [16 bits]        | When the data type is converted to the double word [unsigned]/bit string [32 bits] or double word [signed], the value is automatically zero extended.*2<br>When the data type is converted to the single-precision real number or double-precision real number, the value is automatically converted to the same value as the integer before conversion.*1 |
| Double word [signed]                        | When the data type is converted to the double-precision real number, the value is automatically converted to the same value as the integer before conversion.                                                                                                                                                                                              |
| Double word [unsigned]/bit string [32 bits] |                                                                                                                                                                                                                                                                                                                                                            |
| Single-precision real number                | When the data type is converted to the double-precision real number, the value is automatically converted to the same value.                                                                                                                                                                                                                               |

\*1 When 16-bit data (word [signed] or word [unsigned]/bit string [16 bits]) is passed to the input argument of which data type is ANY\_REAL, the data is automatically converted to single-precision real number.

\*2 When data (word [unsigned]/bit string [16 bits]) is passed to the input argument of which data type is ANY32, the data is automatically converted to double word [unsigned]/bit string [32 bits].

For the data types other than the above, use the type conversion functions.

Use the type conversion functions for the following conversions as well.

- Type conversion between integral data types with different signs
- Type conversion between data types both of which lose data

For the precautions on assignment of the arithmetic operation result, refer to the following.

📖 Page 101 When the result of an arithmetic operation is assigned

For the precautions on the use of devices, refer to the following.

📖 Page 108 When performing automatic conversion of data type with devices

## Subprogram control statements

### ■Function block call statement

| Format                                                                                                           | Description                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Instance name (input variable1:=variable1,...output variable1=>variable2,...);                                   | Enclose the assignment statements to the input and output variables in '()' after the instance name.<br>When using multiple variables, delimit individual assignment statements with a comma ','. |
| Instance name.input variable1:=variable1;<br>:<br>Instance name();<br>Variable2:=instance name.output variable1; | List the assignment statements to input and output arguments between function block call statements.                                                                                              |

The following table lists the symbols used in the arguments of the function block call statements and the expressions that can be assigned.

| Type                               | Description           | Symbol used | Assignable expression |
|------------------------------------|-----------------------|-------------|-----------------------|
| EN, VAR_INPUT                      | Input variable        | :=          | All expressions       |
| ENO, VAR_OUTPUT, VAR_OUTPUT_RETAIN | Output variable       | =>          | Only variables        |
| VAR_IN_OUT                         | Input/output variable | :=          | Only variables        |

The execution result of a function block is stored by specifying an output variable after the instance name with a period "." and assigning the result to the specified variable.

| Function block                                        | FB definition                                                                                                                                                          | Example                                                                                                  |
|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Having one input variable and one output variable     | FB name: FBADD<br>FB instance name: FBADD1<br>Input variable1: IN1<br>Output variable1: OUT1                                                                           | FBADD1(IN1:= Input1 );<br>Output1 := FBADD1.OUT1;                                                        |
| Having three input variables and two output variables | FB name: FBADD<br>FB instance name: FBADD1<br>Input variable1: IN1<br>Input variable2: IN2<br>Input variable3: IN3<br>Output variable1: OUT1<br>Output variable2: OUT2 | FBADD1(IN1:= Input1 ,IN2:= Input2 ,IN3:= Input3 );<br>Output1 := FBADD1.OUT1;<br>Output2 := FBADD1.OUT2; |

### ■Function call statement

Function without a return value, or includes VAR\_OUTPUT variable in parameters can be executed as a statement by adding ";" (semicolon) after the function call statement.

| Format                                   | Description                                                                                                             |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Function name (variable1,variable2,...); | Enclose arguments in "()" following the function name.<br>When using multiple variables, delimit them with a comma ",". |

### ■RETURN statement

| Control statement | Format  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Example                             |
|-------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| ■RETURN           | RETURN; | The statement is used to terminate a program, function block, or function during operation.<br>When the RETURN statement is used in a program, control jumps to the step next to the last statement in the program.<br>When the RETURN statement is used in a function block, control returns from the function block.<br>When the RETURN statement is used in a function, control returns from the function.<br>A single RETURN statement uses one point of the pointer type label in the system. | IF bool1 THEN<br>RETURN;<br>END_IF; |



## Select statements

| Control statement | Format                                                                                                                                                                                                                | Description                                                                                                                                                                                                                                                                                                                                                                                               | Example                                                                                                                               |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| ■IF THEN          | IF<boolean expression>THEN<br><statement...>;<br>END_IF;                                                                                                                                                              | The statement is executed if the boolean expression (conditional formula) is TRUE. The statement is not executed if the boolean expression is FALSE.<br><br>Any expression can be used for the boolean expression if it returns TRUE or FALSE as the boolean operation result of a single bit variable expression or a complicated expression including many variables.                                   | IF bool1 THEN<br>intV1 := intV1 + 1;<br>END_IF;                                                                                       |
| ■IF...ELSE        | IF<boolean expression>THEN<br><statement 1...>;<br>ELSE<br><statement 2...>;<br>END_IF;                                                                                                                               | Statement 1 is executed if the boolean expression (conditional formula) is TRUE.<br><br>If the boolean expression is FALSE, statement 2 is executed.                                                                                                                                                                                                                                                      | IF bool1 THEN<br>intV3 := intV3 + 1;<br>ELSE<br>intV4 := intV4 + 1;<br>END_IF;                                                        |
| ■IF...ELSIF       | IF<boolean expression 1>THEN<br><statement 1...>;<br>ELSIF<boolean expression 2>THEN<br><statement 2...>;<br>ELSIF<boolean expression 3>THEN<br><statement 3...>;<br>END_IF;                                          | Statement 1 is executed if boolean expression 1 (conditional formula) is TRUE. If boolean expression 1 is FALSE and boolean expression 2 is TRUE, statement 2 is executed.<br><br>If boolean expressions 1 and 2 are FALSE and boolean expression 3 is TRUE, statement 3 is executed.                                                                                                                     | IF bool1 THEN<br>intV1 := intV1 + 1;<br>ELSIF bool2 THEN<br>intV2 := intV2 + 2;<br>ELSIF bool3 THEN<br>intV3 := intV3 + 3;<br>END_IF; |
| ■CASE             | CASE<integer expression>OF<br><selected integer 1>:<br><statement 1...>;<br><selected integer 2>:<br><statement 2...>;<br>:<br><selected integer n>:<br><statement n...>;<br>ELSE<br><statement n+1...>;<br>END_CASE; | The statement that has a selected integer value matching the value of the integer expression (conditional formula) is executed, and if no statement has a matching value, the statement following the ELSE statement is executed.<br><br>The CASE statement can be used to execute a select statement according to a single integer value or the integer value of the result of a complicated expression. | CASE intV1 OF<br>1:<br>bool1 := TRUE;<br>2:<br>bool2 := TRUE;<br>ELSE<br>intV1 := intV1 + 1;<br>END_CASE;                             |

## Iteration statements

| Control statement | Format                                                                                                                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Example                                                               |
|-------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| ■FOR...DO         | FOR<iteration variable initialization><br>TO<final value><br>BY<increase expression>DO<br><statement...>;<br>END_FOR; | Data to be used as an iteration variable is initialized.<br><br>One or more statements between the DO statement and the END_FOR statement are executed repeatedly, adding or subtracting the initialized iteration variable according to the increase expression until the final value is exceeded.<br><br>The iteration variable after the FOR...DO statement is completed retains the value at the end of the processing.                                                       | FOR intV1 := 0<br>TO 30<br>BY 1 DO<br>intV3 := intV1 + 1;<br>END_FOR; |
| ■WHILE...DO       | WHILE<boolean expression>DO<br><statement...>;<br>END_WHILE;                                                          | One or more statements are executed while the boolean expression (conditional formula) is TRUE.<br><br>The boolean expression is determined before execution of the statement and, if it is FALSE, any statement in the DO...END_WHILE statement is not executed. Since <boolean expression> in the WHILE statement is only necessary to return TRUE or FALSE as the result, any expression that can be specified in <boolean expression> of the IF statement can be used.        | WHILE intV1 = 30 DO<br>intV1 := intV1 + 1;<br>END_WHILE;              |
| ■REPEAT...UNTIL   | REPEAT<br><statement...>;<br>UNTIL<boolean expression><br>END_REPEAT;                                                 | One or more statements are executed while the boolean expression (conditional formula) is FALSE.<br><br>The boolean expression is determined after execution of the statement and, if the value is TRUE, any statement in the REPEAT...UNTIL statement is not executed. Since <boolean expression> in the REPEAT statement is only necessary to return TRUE or FALSE as the result, any expression that can be specified in <boolean expression> of the IF statement can be used. | REPEAT<br>intV1 := intV1 + 1;<br>UNTIL intV1 = 30<br>END_REPEAT;      |

| Control statement | Format | Description                                                                                                                                                                                                                                                                                                                                                                                                  | Example                                                                                                    |
|-------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| ■EXIT             | EXIT;  | <p>This statement can be used only within an iteration statement to terminate the iteration statement in the middle of processing.</p> <p>When the EXIT statement is reached during execution of the iteration loop, the iteration loop processing after the EXIT statement is not executed. The program execution continues from the line next to the one where the iteration statement was terminated.</p> | <pre> FOR intV1 := 0   TO 10   BY 1 DO     IF intV1 &gt; 10 THEN       EXIT;     END_IF;   END_FOR; </pre> |

## Precautions

### ■When an assignment statement is used

- Up to 255 characters can be assigned to a string. If characters are assigned exceeding the valid range, a conversion error occurs.
- Timer type and counter type contacts and coils cannot be used at the left side of an assignment statement.
- Instances of function blocks cannot be used at the left side of an assignment statement. Use the input variable, output variable, or external variable of an instance.

### ■When the result of an arithmetic operation is assigned

When assigning the result of an arithmetic operation to a data type variable with larger data size, convert the variable of the arithmetic operational expression to the data type of the left side in advance.

#### Ex.

To assign the arithmetic operation result with a data size of 16 bits (INT type) to the 32-bit data type (DINT type):

```
varDint1 := varInt1 * 10; //The varInt1 is an INT type variable, and the varDint1 is a DINT type variable.
```

The result of the arithmetic operation will be the same data type as the input operand. For this reason, if the operation result of `varInt1*10` in the above program exceeds the INT type range (-32768 to 32767), the operation result of overflow or underflow is assigned to `varDint1`.

In this case, convert the operand of the operational expression to the data type of the left side in advance.

```
varDint2 := INT_TO_DINT( varInt1 ); //An INT type variable is converted to a DINT type variable.
```

```
varDint1 := varDint2 * 10; //Multiplication is performed in DINT type, and the operation result is assigned.
```

### ■When a sign inversion operator is used in the arithmetic operational expression

If a sign inversion operator is used for the minimum value of each data type, the value remains unchanged.

For example, the minimum value of INT type data will be  $-(-32768) = -32768$ .

If a sign inversion operator is used for variables targeted for automatic conversion of data type, an intended operation result may not be obtained.

**Ex.**

When the value of varInt1 (INT type) is -32768 and the value of varDint1 (DINT type) is 0

```
varDint2 := -varInt1 + varDint1;
```

In this program, the value of (-varInt1) remains unchanged. Therefore, the value, -32768, is assigned to varDint2.

To use a sign inversion operator in an arithmetic operational expression, automatically convert data type before the arithmetic operation or do not use a sign inverted operator in the program.

**Ex.**

When data type is automatically converted before the arithmetic operation

```
varDint3 := varInt;
```

```
varDint2 := -varDint3 + varDint1;
```

**Ex.**

When a sign inversion operator is not used

```
varDint2 := varDint1 - varInt1
```

### ■When the data type is converted from single-precision real number to double-precision real number

When the type conversion function, REAL\_TO\_LREAL, is executed, an error may occur in the conversion result.

Consequently, when the data type is automatically converted or when a function with a return value of real number type (such as SIN function) is used as the right side of an assignment statement or an operand of arithmetic operational expression, an intended operation result may not be obtained.

**Ex.**

An error occurs.

```
varReal1 := -1234.567;
```

```
varLReal1 := ABS(varReal1);
```

In the above program, the data type of the return value of ABS(varReal1) is single-precision real number. Since the return value is converted to a double-precision real number and assigned to varReal1, an error occurs.

Create a program using a function with the data type same as the assignment target.

**Ex.**

No error occurs.

```
varLReal2 := -1234.567;
```

```
varLReal1 := ABS(varLReal2);
```

## ■When a bit type label is used

Once the boolean expression (conditional formula) is established in a select or iteration statement and if a bit type label is set to on in <statement>, the state of the label will be always on.

**Ex.**

Program that keeps the label status on

| ST program                                            | Ladder program performing the processing equivalent to ST program                  |
|-------------------------------------------------------|------------------------------------------------------------------------------------|
| <pre>IF bLabel1 THEN   bLabel2 := TRUE; END_IF;</pre> |  |

To prevent the label from being always on, add a program that turns off the bit type label as shown below.

**Ex.**

Program that avoids the label from being always on

| ST program <sup>*1</sup>                                                       | Ladder program performing the processing equivalent to ST program                  |
|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <pre>IF bLabel1 THEN   bLabel2 := TRUE; ELSE   bLabel2 := FALSE; END_IF;</pre> |  |

<sup>\*1</sup> The above program can also be described as follows.

bLabel2:=bLabel1;

or

OUT(bLabel1,bLabel2);

Note however that if the OUT instruction is used in the <statement>, the program will be in the same state as a program that keeps the label status on.

## ■When a timer function block or counter function block is used

In a select statement, a boolean expression (conditional formula) differs from the execution conditions of timer function blocks or counter function blocks.

**Ex.**

Timer function block

Program example before change

```
IF bLabel1 THEN
  TIMER_100_FB_M_1 (Coil := bLabel2, Preset := wLabel3, ValueIn := wLabel4, ValueOut => wLabel5, Status => bLabel6);
END_IF;
(*When bLabel1 is on and bLabel2 is also on, counting starts.*)
(*When bLabel1 is on and bLabel2 is off, the counted value is cleared.*)
(*When bLabel1 is off and bLabel2 is on, counting stops. The counted value is not cleared.*)
(*When bLabel1 is off and bLabel2 is also off, counting stops. The counted value is not cleared.*)
```

Program example after change

```
TIMER_100_FB_M_1 (Coil := (bLabel1 & bLabel2), Preset := wLabel3, ValueIn := wLabel4, ValueOut => wLabel5, Status => bLabel6);
```

**Ex.**

Counter function block

Program example before change

```
IF bLabel1 THEN
  COUNTER_FB_M_1 (Coil := bLabel2, Preset := wLabel3, ValueIn := wLabel4, ValueOut => wLabel5, Status => bLabel6);
END_IF;
(*When bLabel1 is on and bLabel2 is on/off, the value is incremented by one.*)
(*When bLabel1 is off and bLabel2 is on/off, the value is not counted.*)
(*The counting operation does not depend on the on/off status of bLabel1.*)
```

Program example after change

```
COUNTER_FB_M_1 (Coil := (bLabel1 & bLabel2), Preset := wLabel3, ValueIn := wLabel4, ValueOut => wLabel5, Status => bLabel6);
```

The above examples of programs before change cause problems because the statement related to the timer or counter is not executed unless the select statement is established.

To operate the timer or counter on the basis of the bLabel1 condition and bLabel1 AND condition, do not use control statements but use only function blocks.

The timer and counter can be operated by using the programs after change.

## ■When a FOR...DO statement is used

- A structure member or array element cannot be used for the iteration variable.
- Match the type used in the iteration variable with the types of <final value expression> and <increase expression>.
- <Increase expression> can be omitted. If omitted, <increase expression> is assumed to be 1.
- If 0 is assigned to <increase expression>, the portions after the FOR statement may no longer be executed or an infinite loop may occur.
- In the FOR...DO statement, the iteration variable count processing is performed after execution of <statement--> in the FOR statement. If the count processing is executed in such a way that it exceeds the maximum value of the iteration variable data type or is below the minimum value, an infinite loop occurs.

## ■When instructions executed at the rising edge or falling edge are used

- If the execution condition of the IF or CASE statement has become FALSE or CASE mismatch, the execution result of the rising edge or falling edge in the IF or CASE statement during the previous scan will not be initialized and will be carried over to the next execution.
- After an iteration statement (FOR, WHILE, or REPEAT statement) ends, the execution result of the rising edge or falling edge in the iteration statement during the previous scan will not be initialized and will be carried over to the next execution.
- The following table lists the operations of when instructions executed at the rising edge or falling edge used in the IF or CASE statement.

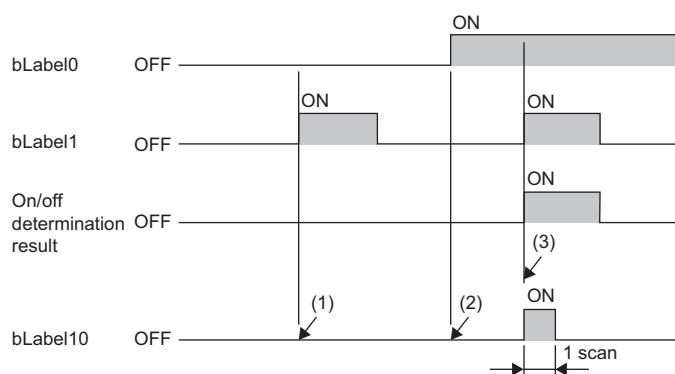
| Condition                                   |                                      |                                                                 | Operation result                               |                                |                                 |
|---------------------------------------------|--------------------------------------|-----------------------------------------------------------------|------------------------------------------------|--------------------------------|---------------------------------|
| Conditional formula of IF or CASE statement | Instruction execution condition (EN) | On/off determination result of the instruction in the last scan | On/off determination result of the instruction | Instruction at the rising edge | Instruction at the falling edge |
| TRUE or CASE match                          | TRUE                                 | On                                                              | On                                             | Not executed                   | Not executed                    |
|                                             |                                      | Off                                                             | On                                             | Executed                       | Not executed                    |
|                                             | FALSE                                | On                                                              | Off                                            | Not executed                   | Executed                        |
|                                             |                                      | Off                                                             | Off                                            | Not executed                   | Not executed                    |
| FALSE or CASE mismatch                      | TRUE                                 | On                                                              | Off                                            | Not executed                   | Not executed <sup>*1</sup>      |
|                                             |                                      | Off                                                             | Off                                            | Not executed                   | Not executed                    |
|                                             | FALSE                                | On                                                              | Off                                            | Not executed                   | Not executed <sup>*1</sup>      |
|                                             |                                      | Off                                                             | Off                                            | Not executed                   | Not executed                    |

\*1 On the falling edge (on to off), the instruction is not executed because the condition of the IF or CASE statement is not satisfied.

### Ex.

When the PLS instruction (execution condition: rising edge) is used in the IF statement

```
IF bLabel0 THEN
    PLS(bLabel1, bLabel10);
END_IF;
```



- (1) When bLabel0 is off (the conditional formula of the IF statement is FALSE), the on/off determination result will be off. The PLS instruction is not executed. (The bLabel10 remains off.)
- (2) When bLabel0 is on (the conditional formula of the IF statement is TRUE) and bLabel1 is off (the instruction execution condition is off), the on/off determination result will be off. The PLS instruction is not executed. (The bLabel10 remains off.)
- (3) When bLabel0 is on (the conditional formula of the IF statement is TRUE) and bLabel1 is also on (the instruction execution condition is on), the on/off determination result will be off to on (rising edge). The PLS instruction is executed. (The bLabel10 is on for one scan.)

- To execute instructions at the rising edge or falling edge in an iteration statement (FOR, WHILE, or REPEAT statement), use the edge relay (V) or perform index modification. In this case, one point of the edge relay (V) is used for each instruction that uses the edge relay (V) in the system. For this reason, secure the edge relay (V) for the number of instructions used in addition to the number of points used in the iteration statement.

**Ex.**

When instructions executed at the rising edge or falling edge are used in the FOR statement

Example of using the edge relay (V) in one location

(The edge relay (V) is used up to a total of 11 points (V0 to V10 for the INC instruction).)

```
FOR Z0 := 0 TO 9 BY 1 DO
  INC(EGP(M100Z0 , V0Z0) , D100Z0);
END_FOR;
```

Example of using the edge relay (V) in two locations

(The edge relay (V) is used up to a total of 22 points (V0 to V10 for the INC instruction, V11 to V21 for the DEC instruction).)

```
FOR Z0 := 0 TO 9 BY 1 DO
  INC(EGP(M100Z0 , V0Z0) , D100Z0);
  DEC(EGF(M200Z0 , V11Z0) , D200Z0);
END_FOR;
```

### ■When the master control instruction is used

Operations when the master control is off will be as follows.

- A statement in the select statement (IF or CASE statement) or iteration statement (FOR, WHILE, or REPEAT statement) performs no processing.
- For a statement outside the select statement or iteration statement, no processing is performed if it is an assignment statement, and a statement itself is not executed if it is other than assignment statement.

**Ex.**

Statement in the select statement (IF statement)

```
MC(M0 , N1 , M1); //Master control is off.
```

```
IF M2 THEN
```

```
  M3 := M4; // M3 retains the value in the last scan because no processing is performed when the master control is off.
```

```
END_IF;
```

```
M20 := MCR(M0, N1);
```

**Ex.**

Statement (bit assignment statement) outside the select statement or iteration statement

```
MC(M0 , N1 , M1); //Master control is off.
```

```
M3 := M4; //M3 retains the value in the last scan because no processing is performed when the master control is off.
```

```
M20 := MCR(M0, N1);
```

**Ex.**

Statement (OUT instruction) outside the select statement or iteration statement

```
MC(M0 , N1 , M1); //Master control is off.
```

```
OUT(M2, M3); //M3 turns off because the instruction is not executed when the master control is off.
```

```
M20 := MCR(M0, N1);
```

# Constants

## Notation of constants

In the ST program, the following notation of constant is available in addition to the standard notation.

| Applicable data type                        | Type                               | Notation <sup>*1</sup>                                                    | Example                                              |
|---------------------------------------------|------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------|
| Bit                                         | Boolean                            | Add "BOOL#" before the boolean value to be used.                          | BOOL#1, BOOL#0<br>BOOL#TRUE, BOOL#FALSE              |
| Word [unsigned]/bit string [16 bits]        | Binary                             | Add "UINT#2#" or "WORD#2#" before a binary number. <sup>*2</sup>          | UINT#2#10101010<br>WORD#2#10101010                   |
|                                             | Octal                              | Add "UINT#8#" or "WORD#8#" before an octal number. <sup>*2</sup>          | UINT#8#3370<br>WORD#8#3370                           |
|                                             | Decimal                            | Add "UINT#" or "WORD#" before a decimal number. <sup>*2</sup>             | UINT#123<br>WORD#123                                 |
|                                             | Hexadecimal                        | Add "UINT#16#" or "WORD#16#" before a hexadecimal number. <sup>*2</sup>   | UINT#16#FF<br>WORD#16#FF                             |
| Double word [unsigned]/bit string [32 bits] | Binary                             | Add "UDINT#2#" or "DWORD#2#" before a binary number. <sup>*2</sup>        | UDINT#2#1100110011001100<br>DWORD#2#1100110011001100 |
|                                             | Octal                              | Add "UDINT#8#" or "DWORD#8#" before an octal number. <sup>*2</sup>        | UDINT#8#33703370<br>DWORD#8#33703370                 |
|                                             | Decimal                            | Add "UDINT#" or "DWORD#" before a decimal number. <sup>*2</sup>           | UDINT#456789<br>DWORD#456789                         |
|                                             | Hexadecimal                        | Add "UDINT#16#" or "DWORD#16#" before a hexadecimal number. <sup>*2</sup> | UDINT#16#FFFF<br>DWORD#16#FFFF                       |
| Word [signed]                               | Binary                             | Add "INT#2#" before a binary number.                                      | INT#2#01010101                                       |
|                                             | Octal                              | Add "INT#8#" before an octal number.                                      | INT#8#3370                                           |
|                                             | Decimal                            | Add "INT#" before a decimal number.                                       | INT#-123                                             |
|                                             | Hexadecimal                        | Add "INT#16#" before a hexadecimal number.                                | INT#16#1F                                            |
| Double word [signed]                        | Binary                             | Add "DINT#2#" before a binary number.                                     | DINT#2#0011001100110011                              |
|                                             | Octal                              | Add "DINT#8#" before an octal number.                                     | DINT#8#33703370                                      |
|                                             | Decimal                            | Add "DINT#" before a decimal number.                                      | DINT#-456789                                         |
|                                             | Hexadecimal                        | Add "DINT#16#" before a hexadecimal number.                               | DINT#16#1F1F                                         |
| Single-precision real number                | Real number                        | Add "REAL#" before a real number.                                         | REAL#2.34                                            |
|                                             | Real number (exponential notation) |                                                                           | REAL#1.0E6                                           |
| Double-precision real number                | Real number                        | Add "LREAL#" before a real number.                                        | LREAL#-2.34                                          |
|                                             | Real number (exponential notation) |                                                                           | LREAL#1.001E16                                       |
| String                                      | STRING                             | Enclose a string (ASCII, Shift JIS) in single quotation marks (').        | 'ABC'                                                |
| String [Unicode]                            | WSTRING                            | Enclose a Unicode string in double quotation marks (").                   | "ABC"                                                |

\*1 Notation of constants are not case-sensitive. Notation of constants with K, H, or E cannot be used simultaneously.

\*2 ANY\_NUM of operand for arithmetic operator, ANY\_NUM of arguments for a function call statement, function block call statement, and function call expression, use the notation of constants with "UINT#" or "UDINT#". For the notation of constants with "WORD#" or "DWORD#", an error occurs during the conversion because the data type is recognized as a bit string.

For the notations of constants other than the above, refer to the following.

 User's manual for the controller used

### Point

In the notation of binary, octal, decimal, hexadecimal, and real numbers, the numbers can be separated using an underscore "\_" to make programs easy to see. The binary number notation of double word [unsigned] can be described as follows.

UDINT#2#1100\_1100\_1100\_1100

The numerical value separation using an underscore "\_" is ignored in program processing.



# Labels and devices

## Specification method

Labels and devices can be directly described on ST programs. Labels and devices can be used for the left or right side of an expression or as an argument or return value of a standard function/function block.

For details on labels and devices, refer to the following.

 User's manual for the controller used

### ■ Notation of devices with a type specifier

A word device can be used as any data type by adding a device type specifier to its name.

| Device specifier | Data type                                                                                                                                                                                                                                                    | Example | Description of example                                                 |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------------------------------------------------------------------|
| None             | Generic data type ANY16.<br>Word [signed], when only devices are used in such as an arithmetic operational expression.<br>However, when it is specified as a device without a type specifier in a FUN/FB argument, it becomes an argument-defined data type. | D0      | D0 without a type specifier                                            |
| :U               | Word [unsigned]/bit string [16 bits]                                                                                                                                                                                                                         | D0:U    | D0 specified as the word [unsigned]/bit string [16 bits]               |
| :D               | Double word [signed]                                                                                                                                                                                                                                         | D0:D    | D0 and D1 specified as the double word [signed]                        |
| :UD              | Double word [unsigned]/bit string [32 bits]                                                                                                                                                                                                                  | D0:UD   | D0 and D1 specified as the double word [unsigned]/bit string [32 bits] |
| :E               | Single-precision real number                                                                                                                                                                                                                                 | D0:E    | D0 and D1 specified as the single-precision real number                |
| :ED              | Double-precision real number                                                                                                                                                                                                                                 | D0:ED   | D0, D1, D2, and D3 specified as the double-precision real number       |

The following devices can use a device type specifier.

- Data register (D)
- Link register (W)
- Link direct device (J□\W□)
- Module access device (U□\G□)
- CPU buffer memory access device (U3E□\G□)
- File register (R/ZR)
- Refresh data register (RD)

A device type specifier cannot be added to a digit-specified or indirect specified device.

### ■ Device specification method

Devices can be specified in the following methods.

- Index modification
- Indirect specification
- Bit specification ( Page 33 Bit data)
- Digit specification ( Page 34 16-bit data (word data),  Page 36 32-bit data (double word data))

For details on index modification and indirect specification, refer to the following.

 User's manual for the controller used

## Precautions

- The pointer type cannot be used in ST programs.
- When the timer, counter, or retentive timer device is used as current value, the data type will be the word [unsigned]/bit string [16 bits]. When the long timer, long counter, or long retentive timer device is used as current value, the data type will be the double word [unsigned]/bit string [32 bits].
- When performing assignment using digit specification, match the data type between the left and right sides.

**Ex.**

```
D0:=K5X40;
```

In this example, a program error occurs because K5X40 is the double word type and D0 is the word type.

- If the right side is greater than the left side when performing assignment using digit specification, data is transferred to within the range of the number of applicable points of the left side.

**Ex.**

```
K5X40:=2#1011_1101_1111_0111_0011_0001;
```

In this example, K5X40 has 20 applicable points and therefore 1101\_1111\_0111\_0011\_0001 (20 digits) is assigned to K5X40.

- When using the current value (such as T<sub>N</sub>) of the counter (C), timer (T), or retentive timer (ST) as a type other than the word [unsigned]/bit string [16 bits], or when using the current value (such as LT<sub>N</sub>) of the long counter (LC), long timer (LT), or long retentive timer (LST) as a type other than the double word [unsigned]/bit string [32 bits], use the type conversion functions.

**Ex.**

```
varInt:=WORD_TO_INT(T0);(*A type conversion function is used.*)
```

### ■When performing automatic conversion of data type with devices

Add a device type specifier when using a word device in a data type other than word [signed]. (  Page 107 Notation of devices with a type specifier)

**Ex.**

When transferring the values of D2 and D3 to dwordLabel1, a double word [unsigned] label

```
//Example of when adding a device type specifier and transferring the values in a correct data type
```

```
dwordLabel1 := D2:UD;
```

```
//Since the data type of D2: UD (D2 with a device type specifier) is double word [unsigned], the values of D2 and D3 are transferred to dwordLabel1.
```

```
//Example of an unintended transfer result
```

```
dwordLabel1 := D2;
```

```
//Since the data type of D2 without a device type specifier is word [signed], the data type is automatically converted into double word [unsigned] and data is transferred to dwordLabel1.
```

```
//Therefore, the value of D3 is not transferred but only the value of D2 is transferred.
```

## Comments

The following table lists the comments that can be used in ST programs.

| Type                  | Symbol | Description                                                                                                                          | Example                                                                                                                                                       |
|-----------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Single-line comment   | //     | The portion from the start symbol "//" to the end of the line is regarded as a comment.                                              | //comment                                                                                                                                                     |
| Multiple-line comment | (**)   | The portion from the start symbol "(" to the end symbol ")" is regarded as a comment.<br>A line feed can be inserted in a comment.   | <div> <div>■</div>No line feed<br/>(*comment*)           </div> <div> <div>■</div>With a line feed<br/>(*line-1 comment<br/>line-2 comment*)           </div> |
|                       | /**/   | The portion from the start symbol "/*" to the end symbol "*/" is regarded as a comment.<br>A line feed can be inserted in a comment. | <div> <div>■</div>No line feed<br/>/*comment*/           </div> <div> <div>■</div>With a line feed<br/>/*line-1 comment<br/>line-2 comment*/           </div> |

Do not write a comment containing an end symbol in a multiple-line comment.

# 5 FBD/LD

FBD/LD (function block diagram/ladder diagram) is a graphic language which describes programs by connecting blocks that perform predefined processing, variable elements, and constant elements along the flow of data and signals.

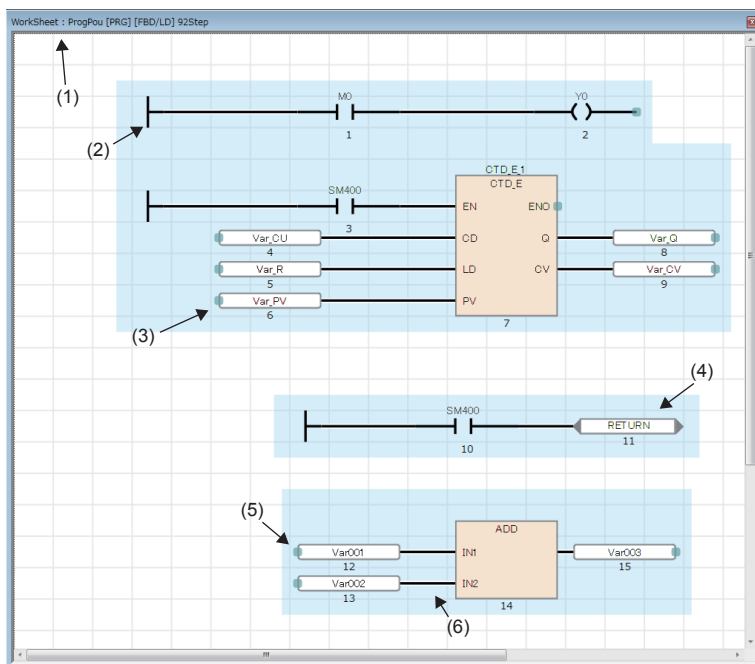
## Point

- This chapter describes the operation and specifications of the FBD/LD. For the operation method of the engineering tool for creating an FBD/LD program, refer to the following.

📖 GX Works3 Operating Manual

## 5.1 Configuration

The following are the programs written in FBD/LD.



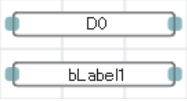
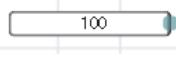
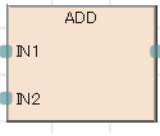
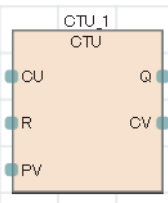
- (1) Worksheet
- (2) LD element
- (3) FBD element
- (4) Common element
- (5) Connection point
- (6) Connection line

In FBD/LD programs, data flows from the output point of a function block, function, variable (label or device), or constant to the input point of another function block or variable.

# Program elements

## FBD elements

The following table lists FBD elements consisting an FBD/LD program.

| Item                |                                                                                   | Description                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Variable            |  | Stores a value. A specific data type is assigned to each variable, and only data of the assigned data type are stored.<br>Labels and devices can be specified as a variable.                                                                                                                                                                                                             |
| Constant            |  | Outputs a specified value.                                                                                                                                                                                                                                                                                                                                                               |
| Function (FUN)      |  | Executes a function. <ul style="list-style-type: none"> <li>How to create functions (📖 GX Works3 Operating Manual)</li> <li>Standard function (👉 Page 183 Standard Functions)</li> </ul>                                                                                                                                                                                                 |
| Function block (FB) |  | Executes a function block. <ul style="list-style-type: none"> <li>How to create function blocks (📖 GX Works3 Operating Manual)</li> <li>Standard function block (👉 Page 194 Standard Function Blocks)</li> <li>Motion control function block (👉 Page 196 MOTION CONTROL FUNCTION BLOCK LIST)</li> <li>Module function blocks (📖 Function Block Reference for the module used)</li> </ul> |

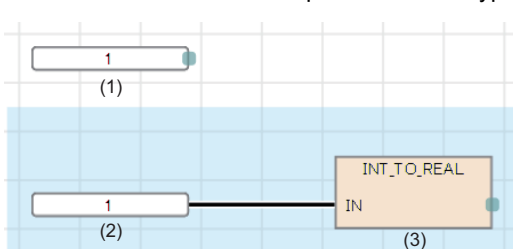
### ■Data type of constant elements

The data type of the value input to a constant is not determined when the value is input. It is determined when the constant element is connected to another FBD element with a connection line. The data type will be the same as that of the connected FBD element.

#### Ex.

When the constant value is 1

The possible data types are BOOL, WORD, DWORD, INT, DINT, REAL, and LREAL, but the data type of the input value cannot be determined at this point. The data type is determined when the constant is connected to another FBD element.



- (1) The data type has not been determined.
- (2) INT data type
- (3) INT data type

### ■Automatic conversion of data type

If the data types differ between connected elements, one data type may be converted automatically.

To prevent data from being lost during type conversion, conversion is performed only from a smaller size data type to a larger size data type. The data type automatic conversion processing in FBD/LD is same as that in ST language. For details, refer to the following.

👉 Page 97 Automatic conversion of data type

■Input/output points of a function

- Connect all input points of a function with another element.
- The data type is assigned to each input variable and output variable of a function. Match the data type of an element connected to the input point or output point with that of the input variable or output variable.

■Precautions for connecting the output variables of the function with EN and function block with EN to another element

When ENO of the function with EN and function block with EN are FALSE (not executed), the program operation differs depending on the element connected.

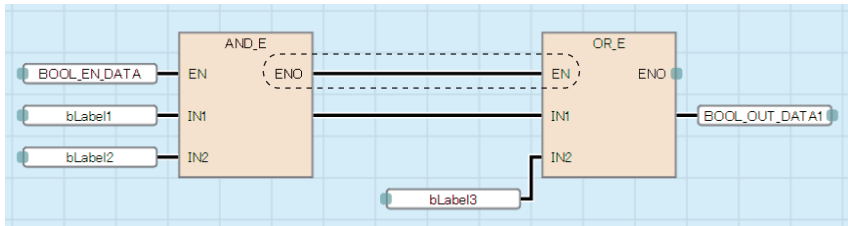
| Element connected                                           | Program operation when ENO of the function with EN and function block with EN are FALSE (not executed)                                                                         |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div><div>• Function</div><div>• Function block</div></div> | The values of the input variables connected to the output variables of the function with EN and function block with EN are undefined.                                          |
| Coil                                                        | The values of the coils connected to the output variables of the function with EN and function block with EN are FALSE. When inverse coils are connected, the values are TRUE. |
| Other than above                                            | The values of the elements connected to the output variables of the function with EN and function block with EN are not changed. (The last values are input.)                  |

Unintended operation may occur if the output variable of the function block with EN is directly connected to the input variable of other functions or function blocks.

To prevent an undefined value from being used, refer to either of the following examples for the connection.

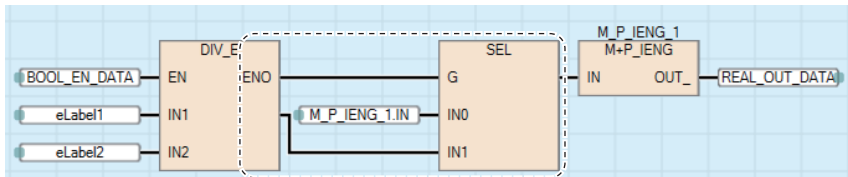
Ex.

Connect elements so that the function with EN or function block with EN is the connection destination. Connect ENO (connection source) to EN (connection destination) as well.



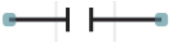
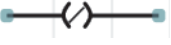
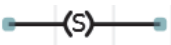
Ex.

Connect elements using the SEL (selection function) so that the last value is input if ENO is FALSE.



## LD elements

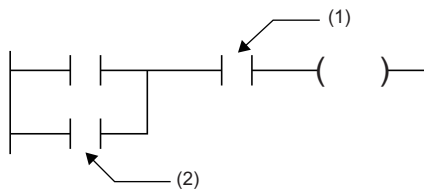
The following table lists the LD elements that can be used in FBD/LD programs.

| Item                       |                                                                                   | Description                                                                                                                                                        |
|----------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Left rail                  |  | An element that indicates a rail.<br>A start point of ladder program.<br>The output of the left rail is always on.                                                 |
| Normally open contact      |  | Energized when the specified device or label is on.                                                                                                                |
| Normally closed contact    |  | Energized when the specified device or label is off.                                                                                                               |
| Rising edge pulse          |  | Energized on the rising edge (off to on) of the specified device or label.                                                                                         |
| Falling edge pulse         |  | Energized on the falling edge (on to off) of the specified device or label.                                                                                        |
| Negated rising edge pulse  |  | Energized when the specified device or label is off, on, or on the falling edge (on to off).                                                                       |
| Negated falling edge pulse |  | Energized when the specified device or label is off, on, or on the rising edge (off to on).                                                                        |
| Coil                       |  | Outputs the operation result to the specified device or label.                                                                                                     |
| Inverse coil               |  | When the operation result turns off, the specified device or label turns on.                                                                                       |
| Set coil                   |  | When the operation result turns on, the specified device or label turns on.<br>The device or label keeps on state even after the operation result turns off.       |
| Reset coil                 |  | When the operation result turns on, the specified device or label turns off.<br>If the operation result is off, the status of the device or label does not change. |

### ■AND operation and OR operation of contact elements

At each contact, an AND operation or OR operation is performed depending on the connection status, and the operation result is output.

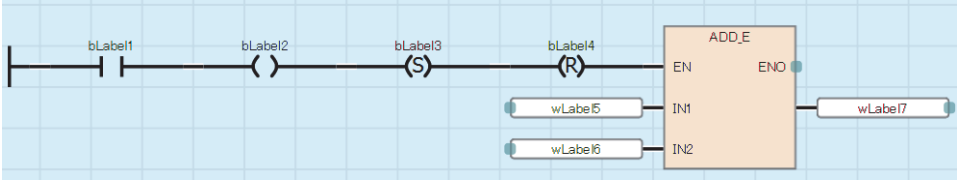
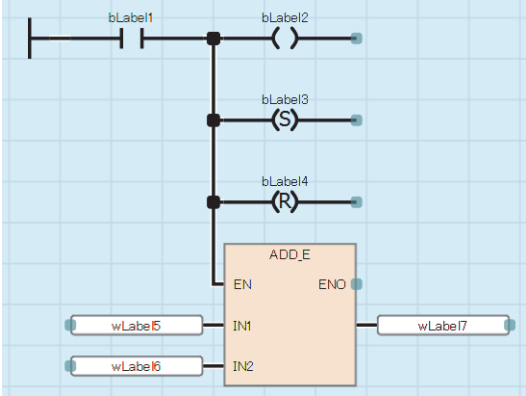
- Series connection (1): An AND operation is performed with the previous operation result.
- Parallel connection (2): An OR operation is performed with the previous operation result.



- (1) Contact connected in series  
(2) Contact connected in parallel

■When another program element is connected to a connection point of coil for output

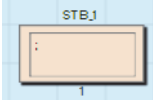
When another program element is connected to a connection point of coil for output in series, the operation is the same as that of the parallel connection.

| Item                           | Description                                                                        |
|--------------------------------|------------------------------------------------------------------------------------|
| Program example                |  |
| Operation at the above example |  |



## Common elements

The following table lists the common elements that can be used in FBD/LD programs.

| Item       |                                                                                   | Description                                                                                                                                                                                                                                                                                                                              |
|------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Jump       |  | Jumps the execution processing to a jump element. Processing between this element and a jump label is not performed.<br>Whether to perform jump processing or not is controlled by inputting on/off information to the element.<br>On: Jump processing performed<br>Off: Jump processing not performed                                   |
| Jump label |  | A jump destination of a jump element in the same program. When the jump processing is performed, the program continues from the processing located after the jump label.                                                                                                                                                                 |
| Connector  |  | Used as a substitute for a connection line.<br>Processing moves to a connector element used as a pair.<br>One or more input connectors can be used as a pair of one output connector.                                                                                                                                                    |
| Return     |  | Stops the execution processing after this element. Use the element not to execute the program, functions, and function blocks after the element.<br>Whether to perform return processing or not is controlled by inputting on/off information to the element.<br>On: Return processing performed<br>Off: Return processing not performed |
| Comment    |  | Used to write a comment.                                                                                                                                                                                                                                                                                                                 |
| Inline ST  |  | Displays an ST program in the FBD/LD editor.<br>Double-clicking an inserted inline ST element displays the ST editor for editing or monitoring an ST program.<br>For details, refer to the following.<br> Page 120 Inline ST                            |

### ■ Jump element

- If the timer whose coil is on is jumped, the time cannot be measured correctly.
- A jump label can be located before the jump element in the program sequence. If located, create a program so that the watchdog timer setting value is not exceeded. (How to exit from a loop must be considered.)
- Specify a pointer type local label for a jump element and a jump label. The structure members cannot be used.
- The CJ, SCJ, and JMP instructions (for pointer branch) cannot be used. Use a jump element when jump processing is required.
- Processing cannot be jumped to/from the outside of the program block.

| Jump related operation                                      | Availability  |
|-------------------------------------------------------------|---------------|
| Jumping to the outside of the program block <sup>*1</sup>   | Not supported |
| Jumping from the outside of the program block <sup>*1</sup> | Not supported |
| Calling a subroutine program                                | Supported     |
| Being called as a subroutine program                        | Not supported |

<sup>\*1</sup> Branching by using the BREAK instruction is included.

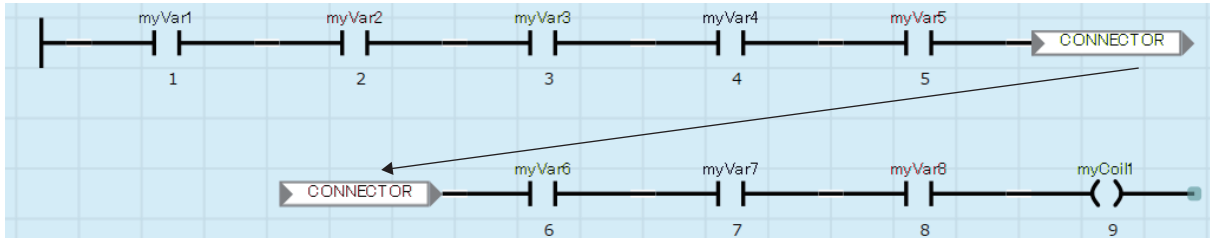
## ■Return element

The operation of a return element differs depending on the POU (program, function, or function block) used.

| POU used       | Description                                                                                                                            |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Program        | Execution of the program is stopped.                                                                                                   |
| Function       | Execution of the function is stopped, and processing returns to the step next to the instruction that called the function.             |
| Function block | Execution of the function block is stopped, and processing returns to the step next to the instruction that called the function block. |

## ■Connector element

A connector element is used to place the program within the area to be displayed in the FBD/LD editor or to be printed.



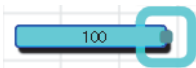
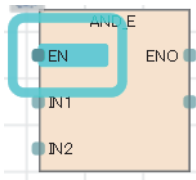
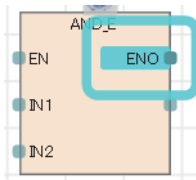
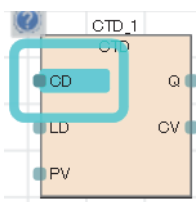
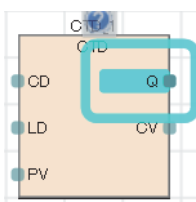
## Connection line

A connection line is a line that connects the end points of FBD element, LD element, and common element. When connected, the value is passed from the left end to the right end of the line. The data types of the program elements connected must be identical, or support automatic data type conversion.

## Connection point

A connection point is an end point of FBD element, LD element, and common element for connecting them to create an FBD/LD program.

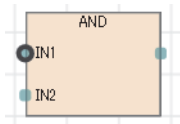
The left-side end point is for input, and the right-side end point is for output.

| Item           | Connection point for input                                                          | Connection point for output                                                                                                               |
|----------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Contact        |    |                                                         |
| Coil           |    |                                                         |
| Variable       |    |                                                         |
| Constant       | —                                                                                   |                                                         |
| Function       |   | <br>The return value of the function is not displayed. |
| Function block |  |                                                       |

When connected, the connection point is hidden.

## I/O point inversion

The input value to a program element or the output value from a program element can be inverted at the connection point. The connection point where the value is inverted (FALSE to TRUE or TRUE to FALSE) is displayed with a black circle.

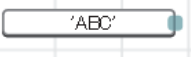
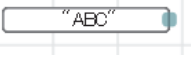


The value of the following data types can be inverted: BOOL, WORD, DWORD, ANY\_BIT, and ANY\_BOOL.

# Constant

## Notation of constants

The following table lists the notations of strings in FBD/LD programs.

| Data type        |         | Notation                                                           | Example                                                                             |
|------------------|---------|--------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| String           | STRING  | Enclose a string (ASCII, Shift JIS) in single quotation marks ('). |  |
| String [Unicode] | WSTRING | Enclose a Unicode string in double quotation marks (").            |  |

For the notations of constants other than the above, refer to the following.

 User's manual for the controller used

## Labels and devices

### Specification method

Labels and devices can be directly described on FBD/LD programs. Labels and devices can be used as an input point or output point of a program element and an argument or return value of a standard function/function block.

For details on labels and devices, refer to the following.

 User's manual for the controller used

#### ■ Notation of devices with a type specifier

A word device can be used as any data type by adding a device type specifier to its name.

The device type specifiers and applicable devices are the same as those for ST programs. For details, refer to the following.

 Page 107 Notation of devices with a type specifier

If the data type of a word device is not specified, it will be determined by the device type.

| Word device                                                                                                                      | Data type |
|----------------------------------------------------------------------------------------------------------------------------------|-----------|
| Current value of the timer (TN), current value of the retentive timer (STN), current value of the counter (CN)                   | WORD      |
| Current value of the long timer (LTN), current value of the long retentive timer (LSTN), current value of the long counter (LCN) | DWORD     |
| Long index register (LZ)                                                                                                         | DINT      |
| Other than above                                                                                                                 | ANY16     |

Precautions

■When labels are used

Local devices cannot be used as an array index. To use local devices as an array index, assign the target device to another device, and specify the assigned device.

■When performing automatic conversion of data type with devices

Add a device type specifier when using a word device in a data type other than word [signed]. (  Page 118 Notation of devices with a type specifier)

Ex.

When the values of D2 and D3 are transferred to dwordLabel1, a double word [unsigned] label

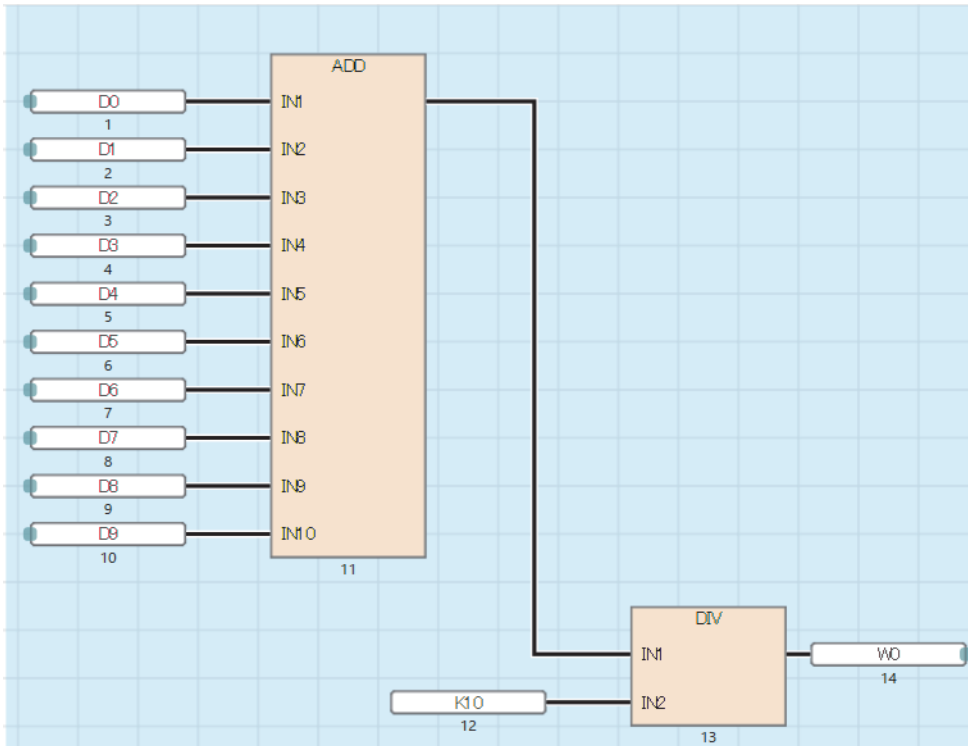
| Example of when adding a device type specifier and transferring the values in a correct data type                                                                                                                                                     | Example of an unintended transfer result                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div></div> <p>Since the data type of D2:UD (D2 with a device type specifier) is double word [unsigned], the values of D2 and D3 are transferred to dwordLabel1.</p> | <div></div> <p>Since the data type of D2 without a device type specifier is word [signed], the data type is automatically converted into double word [unsigned] and data is transferred to dwordLabel1.<br/>Therefore, the value of D3 is not transferred but only the value of D2 is transferred.</p> |

## 5.2 Inline ST

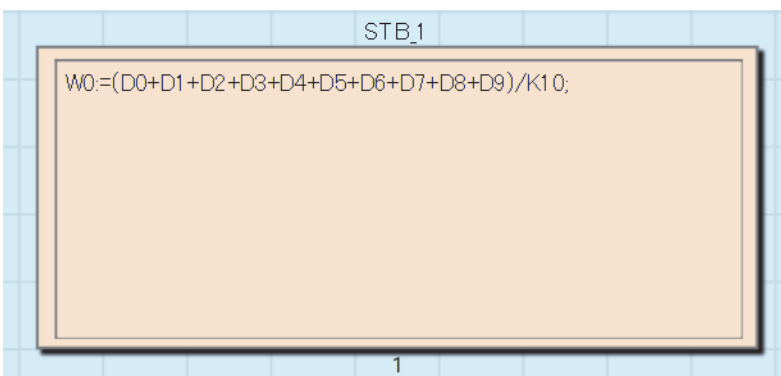
The inline ST is the function used to create an inline ST element that displays an ST program in the FBD/LD editor, and edit and monitor it.

This function enables to create complex numerical operations and string processing easily in FBD/LD programs.

- Program that does not use the inline ST



- Program that uses the inline ST



### Specifications

Double-clicking an inserted inline ST element displays the ST editor for editing or monitoring an ST program.

For the specifications of the ST program described to the inline ST, refer to the specifications of the ST language.

☞ Page 92 STRUCTURED TEXT LANGUAGE

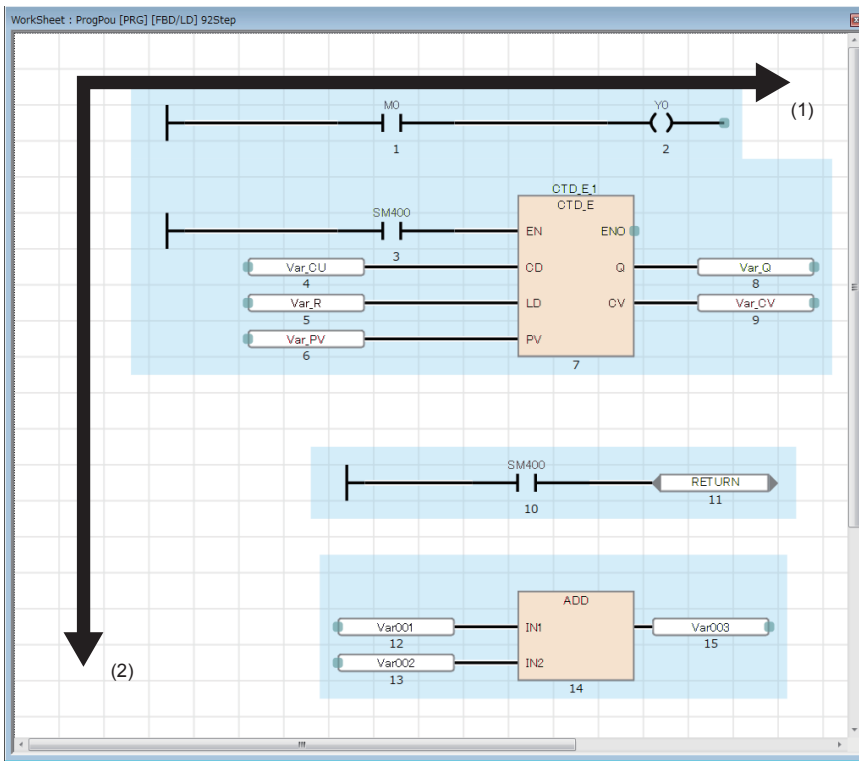
### Precautions

- Up to 64 inline ST elements can be inserted into a single POU of an FBD/LD program.
- Using a RETURN statement in the inline ST causes the processing in the inline ST element to end, instead of the processing of the program block.
- Since inline ST elements have no connection points, an inline ST element inserted into an FBD/LD program is executed every scan.

## 5.3 Program Execution Order

### Execution order of program elements

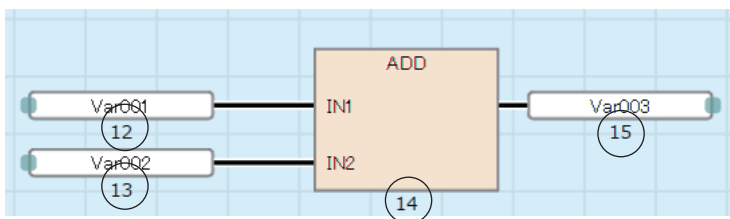
The execution order of program elements in the FBD/LD editor is determined by the location and connecting status.



(1) Program elements are executed from left to right.

(2) Program elements are executed from top to bottom.

The execution order is displayed under each program element. After the program is converted, the determined execution order is displayed.

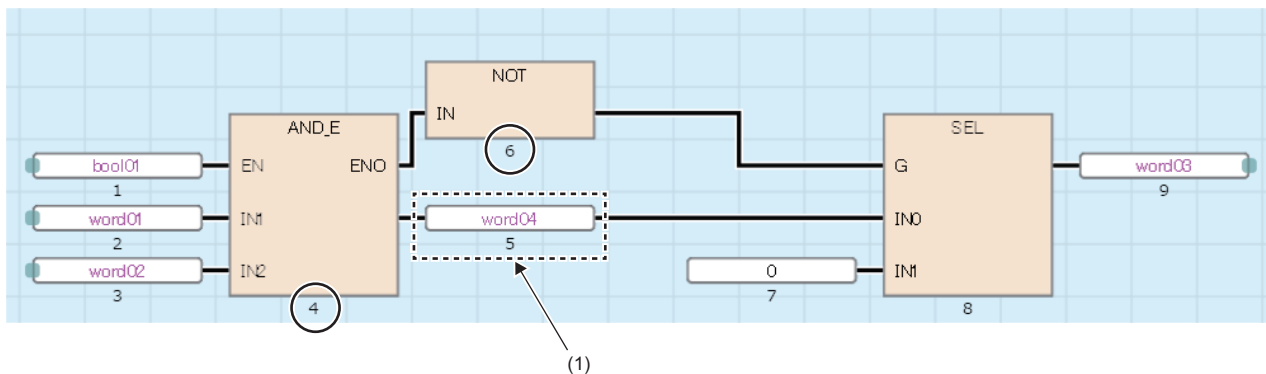


## Precautions

For a program that uses functions, do not directly connect the return value of a function and an input variable of another function, but connect a variable element between them.

**Ex.**

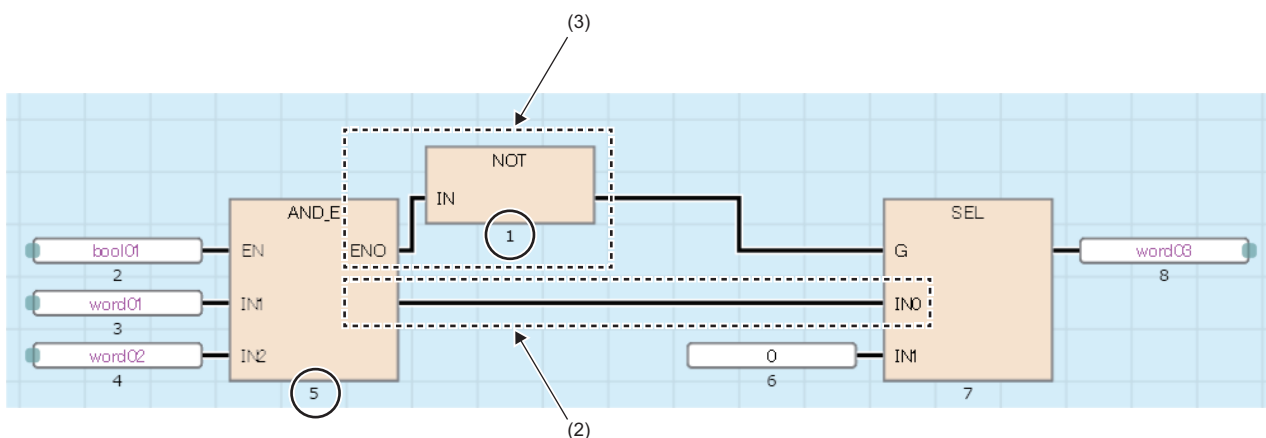
When the variable element (1) is connected between the return value and input variable



Connecting the return value of a function and the input variable of another function directly may lead an execution order to an unintended one.

**Ex.**

An unintended execution order



Since both the output variable (3) that comes from another program element and the return value (2) of the program element arranged on the left are connected as inputs of the program element arranged on the right, the execution order has changed.



## PART 2

# LISTS OF INSTRUCTIONS AND FUN/FB

This part consists of the following chapters.

6 INSTRUCTION LIST

---

7 NETWORK INSTRUCTION LIST

---

8 STANDARD FUNCTION/STANDARD FUNCTION BLOCK LISTS

---

9 MOTION CONTROL FUNCTION BLOCK LIST

---

10 NETWORK FUNCTION BLOCK LIST

---

# 6

## INSTRUCTION LIST

The following table summarizes how to read the instruction lists.

| Item               | Description                                     |
|--------------------|-------------------------------------------------|
| Instruction symbol | An instruction name                             |
| Processing details | An overview of the instruction                  |
| Reference          | Section where detailed information is described |

## 6.1 Sequence Instructions

### Contact instructions

#### ■ Operation start, series connection, parallel connection

| Instruction symbol | Processing details                                                                                                                                                                                                   | Reference                           |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| LD                 | Outputs the on/off information of the specified device as the operation result. (Normally open contact operation start instruction)                                                                                  | Page 206 LD, LDI, AND, ANI, OR, ORI |
| LDI                | Outputs the on/off information of the specified device as the operation result. (Normally closed contact operation start instruction)                                                                                |                                     |
| AND                | Performs an AND operation between the on/off information of the specified device and the previous operation result, and output the operation result. (Normally open contact series connection instruction)           |                                     |
| ANI                | Performs an AND operation between the on/off information of the specified device and the previous operation result, and output the operation result. (Normally closed contact series connection instruction)         |                                     |
| OR                 | Performs an OR operation between the on/off information of the specified device and the previous operation result, and output the operation result. (Single normally open contact parallel connection instruction)   |                                     |
| ORI                | Performs an OR operation between the on/off information of the specified device and the previous operation result, and output the operation result. (Single normally closed contact parallel connection instruction) |                                     |

#### ■ Pulse operation start, pulse series connection, pulse parallel connection

| Instruction symbol | Processing details                                                                                                          | Reference                               |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| LDP                | Turns on only at the rising edge (off to on) of the specified bit device. (Rising edge pulse operation start instruction)   | Page 208 LDP, LDF, ANDP, ANDF, ORP, ORF |
| LDF                | Turns on only at the falling edge (on to off) of the specified bit device. (Falling edge pulse operation start instruction) |                                         |
| ANDP               | Performs an AND operation with the previous operation result. (Rising edge pulse series connection instruction)             |                                         |
| ANDF               | Performs an AND operation with the previous operation result. (Falling edge pulse series connection instruction)            |                                         |
| ORP                | Performs an OR operation with the previous operation result. (Rising edge pulse parallel connection instruction)            |                                         |
| ORF                | Performs an OR operation with the previous operation result. (Falling edge pulse parallel connection instruction)           |                                         |

## ■Pulse NOT operation start, pulse NOT series connection, pulse NOT parallel connection

| Instruction symbol | Processing details                                                                                                                     | Reference                                     |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| LDPI               | Turns on when the specified device is off, on, or at the falling edge (on to off). (Rising edge pulse NOT operation start instruction) | Page 211 LDPI, LDFI, ANDPI, ANDFI, ORPI, ORFI |
| LDFI               | Turns on when the specified device is at the rising edge (off to on), off, or on. (Falling edge pulse NOT operation start instruction) |                                               |
| ANDPI              | Performs an AND operation with the previous operation result. (Rising edge pulse NOT series connection instruction)                    |                                               |
| ANDFI              | Performs an AND operation with the previous operation result. (Falling edge pulse NOT series connection instruction)                   |                                               |
| ORPI               | Performs an OR operation with the previous operation result. (Rising edge pulse NOT parallel connection instruction)                   |                                               |
| ORFI               | Performs an OR operation with the previous operation result. (Falling edge pulse NOT parallel connection instruction)                  |                                               |

## Association instructions

### ■Ladder block series/parallel connection

| Instruction symbol | Processing details                                                                        | Reference         |
|--------------------|-------------------------------------------------------------------------------------------|-------------------|
| ANB                | Performs AND operations between logical blocks (series connection between logical blocks) | Page 214 ANB, ORB |
| ORB                | Performs OR operations between logical blocks (series connection between logical blocks)  |                   |

### ■Inverting the operation result

| Instruction symbol | Processing details                                                  | Reference    |
|--------------------|---------------------------------------------------------------------|--------------|
| INV                | Inverts the operation result up to just before the INV instruction. | Page 215 INV |

### ■Converting the operation result into a pulse

| Instruction symbol | Processing details                                                                          | Reference         |
|--------------------|---------------------------------------------------------------------------------------------|-------------------|
| MEP                | Turns on at the rising edge (off to on) of the operation result up to the MEP instruction.  | Page 216 MEP, MEF |
| MEF                | Turns on at the falling edge (on to off) of the operation result up to the MEF instruction. |                   |

### ■Converting the edge relay operation result into a pulse

| Instruction symbol | Processing details                                                                                                                                             | Reference         |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| EGP                | Stores the operation result up to the EGP instruction in the edge relay (V). The instruction turns on at the rising edge (off to on) of the operation result.  | Page 217 EGP, EGF |
| EGF                | Stores the operation result up to the EGF instruction in the edge relay (V). The instruction turns on at the falling edge (on to off) of the operation result. |                   |

## Output instructions

### ■Out (excluding the timer, counter, and annunciator)

| Instruction symbol | Processing details                                    | Reference    |
|--------------------|-------------------------------------------------------|--------------|
| OUT                | Outputs the operation result to the specified device. | Page 219 OUT |

### ■Timer, long timer

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Reference                               |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| OUT T              | <p>Starts time measurement when the operation result up to the OUT instruction is on. When time is up, the normally open contact turns on (continuity state) and the normally closed contact turns off (non-continuity state).</p> <ul style="list-style-type: none"> <li>• OUT T: Low-speed timer instruction</li> <li>• OUTH T: High-speed timer instruction</li> <li>• OUT ST: Low-speed retentive timer instruction</li> <li>• OUTH ST: High-speed retentive timer instruction</li> <li>• OUT LT: Low-speed long timer instruction</li> <li>• OUT LST: Low-speed long retentive timer instruction</li> </ul> | Page 221 OUT T, OUTH T, OUT ST, OUTH ST |
| OUTH T             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                         |
| OUT ST             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                         |
| OUTH ST            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                         |
| OUT LT             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Page 224 OUT LT, OUT LST                |
| OUT LST            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                         |

### ■Counter, long counter

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                                                                                                                                                   | Reference       |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| OUT C              | <p>Increments the current counter value (count value) by one when the operation result up to the OUT instruction turns on. When the count value reaches the set value, the normally open contact of the counter turns on (continuity state) and the normally closed contact turns off (non-continuity state).</p> <ul style="list-style-type: none"> <li>• OUT C: Counter</li> <li>• OUT LC: Long counter</li> </ul> | Page 227 OUT C  |
| OUT LC             |                                                                                                                                                                                                                                                                                                                                                                                                                      | Page 229 OUT LC |

### ■Annunciator

| Instruction symbol | Processing details                                                                     | Reference      |
|--------------------|----------------------------------------------------------------------------------------|----------------|
| OUT F              | Outputs the operation result up to the OUT F instruction to the specified annunciator. | Page 231 OUT F |

### ■Setting devices (excluding annunciator)

| Instruction symbol | Processing details          | Reference    |
|--------------------|-----------------------------|--------------|
| SET                | Turns on the specified bit. | Page 232 SET |

### ■Resetting devices (excluding annunciator)

| Instruction symbol | Processing details                                                                                                                          | Reference    |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| RST                | Turns off the specified device. For the timer and counter, the instruction clears the current value to 0 and turns off the contact or coil. | Page 234 RST |

### ■Setting/resetting annunciator

| Instruction symbol | Processing details                   | Reference      |
|--------------------|--------------------------------------|----------------|
| SET F              | Turns on the specified annunciator.  | Page 236 SET F |
| RST F              | Turns off the specified annunciator. | Page 238 RST F |

### ■Rising/falling edge output

| Instruction symbol | Processing details                                                                                   | Reference    |
|--------------------|------------------------------------------------------------------------------------------------------|--------------|
| PLS                | Turns on the specified device for one scan on the rising edge (off to on) of the execution command.  | Page 240 PLS |
| PLF                | Turns on the specified device for one scan on the falling edge (on to off) of the execution command. | Page 242 PLF |

## ■Inverting the bit device output

| Instruction symbol | Processing details                          | Reference   |
|--------------------|---------------------------------------------|-------------|
| FF                 | Inverts the status of the specified device. | Page 244 FF |

## ■Converting the direct access output into a pulse

| Instruction symbol | Processing details                                                  | Reference         |
|--------------------|---------------------------------------------------------------------|-------------------|
| DELTA              | Converts the specified direct access output (DY) into pulse output. | Page 245 DELTA(P) |
| DELTAP             |                                                                     |                   |

## Shift instructions

### ■Shifting bit devices

| Instruction symbol | Processing details                                                                                                                            | Reference       |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| SFT                | Shifts the on/off state of the device area just before the one specified to the specified device area, and turns off the shift source device. | Page 247 SFT(P) |
| SFTP               |                                                                                                                                               |                 |

## Master control instructions

### ■Setting/resetting a master control

| Instruction symbol | Processing details       | Reference        |
|--------------------|--------------------------|------------------|
| MC                 | Starts a master control. | Page 249 MC, MCR |
| MCR                | Ends a master control.   |                  |

## Termination instructions

### ■Ending the main routine program

| Instruction symbol | Processing details                                                                                    | Reference     |
|--------------------|-------------------------------------------------------------------------------------------------------|---------------|
| FEND               | Separates the main routine program from subroutine programs and interrupt programs in a program file. | Page 253 FEND |

### ■Ending the sequence program

| Instruction symbol | Processing details              | Reference    |
|--------------------|---------------------------------|--------------|
| END                | Indicates the end of a program. | Page 254 END |

## Stop instruction

### ■Stopping the sequence program

| Instruction symbol | Processing details                                                                                                                                   | Reference     |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| STOP               | Stops the operation of the controller. (The operation of this instruction is the same as setting the switch of the controller to the STOP position.) | Page 256 STOP |

## No operation instruction

### ■No operation

| Instruction symbol | Processing details                                                                           | Reference      |
|--------------------|----------------------------------------------------------------------------------------------|----------------|
| NOPLF              | This instruction is a no-operation instruction and has no impact on the previous operations. | Page 257 NOPLF |

## 6.2 Basic Instructions

### Comparison operation instructions

#### ■Comparing 16-bit binary data

| Instruction symbol      | Processing details                                                                                   | Reference                           |
|-------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------|
| LD=, AND=, OR=          | Compares the two sets of 16-bit binary data specified. (Devices are used as normally open contacts.) | Page 258 LD□(_U), AND□(_U), OR□(_U) |
| LD=_U, AND=_U, OR=_U    |                                                                                                      |                                     |
| LD<>, AND<>, OR<>       |                                                                                                      |                                     |
| LD<>_U, AND<>_U, OR<>_U |                                                                                                      |                                     |
| LD>, AND>, OR>          |                                                                                                      |                                     |
| LD>_U, AND>_U, OR>_U    |                                                                                                      |                                     |
| LD<=, AND<=, OR<=       |                                                                                                      |                                     |
| LD<=_U, AND<=_U, OR<=_U |                                                                                                      |                                     |
| LD<, AND<, OR<          |                                                                                                      |                                     |
| LD<_U, AND<_U, OR<_U    |                                                                                                      |                                     |
| LD>=, AND>=, OR>=       |                                                                                                      |                                     |
| LD>=_U, AND>=_U, OR>=_U |                                                                                                      |                                     |

#### ■Comparing 32-bit binary data

| Instruction symbol         | Processing details                                                                                   | Reference                              |
|----------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------|
| LDD=, ANDD=, ORD=          | Compares the two sets of 32-bit binary data specified. (Devices are used as normally open contacts.) | Page 260 LDD□(_U), ANDD□(_U), ORD□(_U) |
| LDD=_U, ANDD=_U, ORD=_U    |                                                                                                      |                                        |
| LDD<>, ANDD<>, ORD<>       |                                                                                                      |                                        |
| LDD<>_U, ANDD<>_U, ORD<>_U |                                                                                                      |                                        |
| LDD>, ANDD>, ORD>          |                                                                                                      |                                        |
| LDD>_U, ANDD>_U, ORD>_U    |                                                                                                      |                                        |
| LDD<=, ANDD<=, ORD<=       |                                                                                                      |                                        |
| LDD<=_U, ANDD<=_U, ORD<=_U |                                                                                                      |                                        |
| LDD<, ANDD<, ORD<          |                                                                                                      |                                        |
| LDD<_U, ANDD<_U, ORD<_U    |                                                                                                      |                                        |
| LDD>=, ANDD>=, ORD>=       |                                                                                                      |                                        |
| LDD>=_U, ANDD>=_U, ORD>=_U |                                                                                                      |                                        |

## ■ Comparing 16-bit binary block data

| Instruction symbol                                                   | Processing details                                           | Reference              |
|----------------------------------------------------------------------|--------------------------------------------------------------|------------------------|
| BKCMPE, BKCMP<>, BKCMP>, BKCMP<=, BKCMP<, BKCMP>=                    | Compares the two sets of 16-bit binary block data specified. | Page 262 BKCMP□(P)(_U) |
| BKCMPE=P, BKCMP<>=P, BKCMP>P, BKCMP<=P, BKCMP<P, BKCMP>=P            |                                                              |                        |
| BKCMPE=_U, BKCMP<>_U, BKCMP>_U, BKCMP<=_U, BKCMP<_U, BKCMP>=_U       |                                                              |                        |
| BKCMPE=P_U, BKCMP<>P_U, BKCMP>P_U, BKCMP<=P_U, BKCMP<P_U, BKCMP>=P_U |                                                              |                        |

## ■ Comparing 32-bit binary block data

| Instruction symbol                                                              | Processing details                                           | Reference                |
|---------------------------------------------------------------------------------|--------------------------------------------------------------|--------------------------|
| DBKCMPE, DBKCMPE<>, DBKCMPE>, DBKCMPE<=, DBKCMPE<, DBKCMPE>=                    | Compares the two sets of 32-bit binary block data specified. | Page 265 DBKCMPE□(P)(_U) |
| DBKCMPE=P, DBKCMPE<>=P, DBKCMPE>P, DBKCMPE<=P, DBKCMPE<P, DBKCMPE>=P            |                                                              |                          |
| DBKCMPE=_U, DBKCMPE<>_U, DBKCMPE>_U, DBKCMPE<=_U, DBKCMPE<_U, DBKCMPE>=_U       |                                                              |                          |
| DBKCMPE=P_U, DBKCMPE<>P_U, DBKCMPE>P_U, DBKCMPE<=P_U, DBKCMPE<P_U, DBKCMPE>=P_U |                                                              |                          |

## Arithmetic operation instructions

### ■Adding/subtracting 16-bit binary data

| Instruction symbol | Processing details                                                                          | Reference                                       |
|--------------------|---------------------------------------------------------------------------------------------|-------------------------------------------------|
| +                  | Adds the two sets of 16-bit binary data specified. (Two operands)                           | Page 268 +(P)(_U) [when two operands are set]   |
| +P                 |                                                                                             |                                                 |
| +_U                |                                                                                             |                                                 |
| +P_U               |                                                                                             |                                                 |
| +                  | Adds the two sets of 16-bit binary data specified. (Three operands)                         | Page 270 +(P)(_U) [when three operands are set] |
| +P                 |                                                                                             |                                                 |
| +_U                |                                                                                             |                                                 |
| +P_U               |                                                                                             |                                                 |
| -                  | Performs subtraction between the two sets of 16-bit binary data specified. (Two operands)   | Page 272 -(P)(_U) [when two operands are set]   |
| -P                 |                                                                                             |                                                 |
| -_U                |                                                                                             |                                                 |
| -P_U               |                                                                                             |                                                 |
| -                  | Performs subtraction between the two sets of 16-bit binary data specified. (Three operands) | Page 274 -(P)(_U) [when three operands are set] |
| -P                 |                                                                                             |                                                 |
| -_U                |                                                                                             |                                                 |
| -P_U               |                                                                                             |                                                 |

### ■Adding/subtracting 32-bit binary data

| Instruction symbol | Processing details                                                                          | Reference                                        |
|--------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------|
| D+                 | Adds the two sets of 32-bit binary data specified. (Two operands)                           | Page 276 D+(P)(_U) [when two operands are set]   |
| D+P                |                                                                                             |                                                  |
| D+_U               |                                                                                             |                                                  |
| D+P_U              |                                                                                             |                                                  |
| D+                 | Adds the two sets of 32-bit binary data specified. (Three operands)                         | Page 278 D+(P)(_U) [when three operands are set] |
| D+P                |                                                                                             |                                                  |
| D+_U               |                                                                                             |                                                  |
| D+P_U              |                                                                                             |                                                  |
| D-                 | Performs subtraction between the two sets of 32-bit binary data specified. (Two operands)   | Page 280 D-(P)(_U) [when two operands are set]   |
| D-P                |                                                                                             |                                                  |
| D-_U               |                                                                                             |                                                  |
| D-P_U              |                                                                                             |                                                  |
| D-                 | Performs subtraction between the two sets of 32-bit binary data specified. (Three operands) | Page 282 D-(P)(_U) [when three operands are set] |
| D-P                |                                                                                             |                                                  |
| D-_U               |                                                                                             |                                                  |
| D-P_U              |                                                                                             |                                                  |

### ■Multiplying/dividing 16-bit binary data

| Instruction symbol | Processing details                                                      | Reference         |
|--------------------|-------------------------------------------------------------------------|-------------------|
| *                  | Multiplies the two sets of 16-bit binary data specified.                | Page 284 *(P)(_U) |
| *P                 |                                                                         |                   |
| *_U                |                                                                         |                   |
| *P_U               |                                                                         |                   |
| /                  | Performs division between the two sets of 16-bit binary data specified. | Page 286 /(P)(_U) |
| /P                 |                                                                         |                   |
| /_U                |                                                                         |                   |
| /P_U               |                                                                         |                   |



## ■ Multiplying/dividing 32-bit binary data

| Instruction symbol | Processing details                                                      | Reference          |
|--------------------|-------------------------------------------------------------------------|--------------------|
| D*                 | Multiplies the two sets of 32-bit binary data specified.                | Page 288 D*(P)(_U) |
| D*P                |                                                                         |                    |
| D*_U               |                                                                         |                    |
| D*P_U              |                                                                         |                    |
| D/                 | Performs division between the two sets of 32-bit binary data specified. | Page 290 D/(P)(_U) |
| D/P                |                                                                         |                    |
| D/_U               |                                                                         |                    |
| D/P_U              |                                                                         |                    |

## ■ Adding/subtracting BCD 4-digit data

| Instruction symbol | Processing details                                                                        | Reference                                    |
|--------------------|-------------------------------------------------------------------------------------------|----------------------------------------------|
| B+                 | Adds the two sets of BCD 4-digit data specified. (Two operands)                           | Page 292 B+(P) [when two operands are set]   |
| B+P                |                                                                                           |                                              |
| B+                 | Adds the two sets of BCD 4-digit data specified. (Three operands)                         | Page 293 B+(P) [when three operands are set] |
| B+P                |                                                                                           |                                              |
| B-                 | Performs subtraction between the two sets of BCD 4-digit data specified. (Two operands)   | Page 295 B-(P) [when two operands are set]   |
| B-P                |                                                                                           |                                              |
| B-                 | Performs subtraction between the two sets of BCD 4-digit data specified. (Three operands) | Page 296 B-(P) [when three operands are set] |
| B-P                |                                                                                           |                                              |

## ■ Adding/subtracting BCD 8-digit data

| Instruction symbol | Processing details                                                                        | Reference                                     |
|--------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------|
| DB+                | Adds the two sets of BCD 8-digit data specified. (Two operands)                           | Page 298 DB+(P) [when two operands are set]   |
| DB+P               |                                                                                           |                                               |
| DB+                | Adds the two sets of BCD 8-digit data specified. (Three operands)                         | Page 299 DB+(P) [when three operands are set] |
| DB+P               |                                                                                           |                                               |
| DB-                | Performs subtraction between the two sets of BCD 8-digit data specified. (Two operands)   | Page 301 DB-(P) [when two operands are set]   |
| DB-P               |                                                                                           |                                               |
| DB-                | Performs subtraction between the two sets of BCD 8-digit data specified. (Three operands) | Page 303 DB-(P) [when three operands are set] |
| DB-P               |                                                                                           |                                               |

## ■ Multiplying/dividing BCD 4-digit data

| Instruction symbol | Processing details                                                    | Reference      |
|--------------------|-----------------------------------------------------------------------|----------------|
| B*                 | Multiplies the two sets of BCD 4-digit data specified.                | Page 305 B*(P) |
| B*P                |                                                                       |                |
| B/                 | Performs division between the two sets of BCD 4-digit data specified. | Page 307 B/(P) |
| B/P                |                                                                       |                |

## ■ Multiplying/dividing BCD 8-digit data

| Instruction symbol | Processing details                                                    | Reference       |
|--------------------|-----------------------------------------------------------------------|-----------------|
| DB*                | Multiplies the two sets of BCD 8-digit data specified.                | Page 309 DB*(P) |
| DB*P               |                                                                       |                 |
| DB/                | Performs division between the two sets of BCD 8-digit data specified. | Page 311 DB/(P) |
| DB/P               |                                                                       |                 |

## ■Adding/subtracting 16-bit binary block data

| Instruction symbol | Processing details                                                        | Reference           |
|--------------------|---------------------------------------------------------------------------|---------------------|
| BK+                | Adds the two 16-bit binary data blocks specified.                         | Page 313 BK+(P)(_U) |
| BK+P               |                                                                           |                     |
| BK+_U              |                                                                           |                     |
| BK+P_U             |                                                                           |                     |
| BK-                | Performs subtraction between the two 16-bit binary data blocks specified. | Page 315 BK-(P)(_U) |
| BK-P               |                                                                           |                     |
| BK-_U              |                                                                           |                     |
| BK-P_U             |                                                                           |                     |

## ■Adding/subtracting 32-bit binary block data

| Instruction symbol | Processing details                                                        | Reference            |
|--------------------|---------------------------------------------------------------------------|----------------------|
| DBK+               | Adds the two 32-bit binary data blocks specified.                         | Page 317 DBK+(P)(_U) |
| DBK+P              |                                                                           |                      |
| DBK+_U             |                                                                           |                      |
| DBK+P_U            |                                                                           |                      |
| DBK-               | Performs subtraction between the two 32-bit binary data blocks specified. | Page 320 DBK-(P)(_U) |
| DBK-P              |                                                                           |                      |
| DBK-_U             |                                                                           |                      |
| DBK-P_U            |                                                                           |                      |

## ■Incrementing/decrementing 16-bit binary data

| Instruction symbol | Processing details                                  | Reference           |
|--------------------|-----------------------------------------------------|---------------------|
| INC                | Increments the specified 16-bit binary data by one. | Page 323 INC(P)(_U) |
| INCP               |                                                     |                     |
| INC_U              |                                                     |                     |
| INCP_U             |                                                     |                     |
| DEC                | Decrements the specified 16-bit binary data by one. | Page 324 DEC(P)(_U) |
| DECP               |                                                     |                     |
| DEC_U              |                                                     |                     |
| DECP_U             |                                                     |                     |

## ■Incrementing/decrementing 32-bit binary data

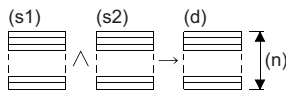
| Instruction symbol | Processing details                                  | Reference            |
|--------------------|-----------------------------------------------------|----------------------|
| DINC               | Increments the specified 32-bit binary data by one. | Page 325 DINC(P)(_U) |
| DINCP              |                                                     |                      |
| DINC_U             |                                                     |                      |
| DINCP_U            |                                                     |                      |
| DDEC               | Decrements the specified 32-bit binary data by one. | Page 326 DDEC(P)(_U) |
| DDECP              |                                                     |                      |
| DDEC_U             |                                                     |                      |
| DDECP_U            |                                                     |                      |

## Logical operation instructions

### ■Performing an AND operation on 16-bit/32-bit data

| Instruction symbol | Processing details                                                                          | Reference                                      |
|--------------------|---------------------------------------------------------------------------------------------|------------------------------------------------|
| WAND               | Performs an AND operation on the two sets of 16-bit binary data specified. (Two operands)   | Page 327 WAND(P) [when two operands are set]   |
| WANDP              |                                                                                             |                                                |
| WAND               | Performs an AND operation on the two sets of 16-bit binary data specified. (Three operands) | Page 328 WAND(P) [when three operands are set] |
| WANDP              |                                                                                             |                                                |
| DAND               | Performs an AND operation on the two sets of 32-bit binary data specified. (Two operands)   | Page 330 DAND(P) [when two operands are set]   |
| DANDP              |                                                                                             |                                                |
| DAND               | Performs an AND operation on the two sets of 32-bit binary data specified. (Three operands) | Page 332 DAND(P) [when three operands are set] |
| DANDP              |                                                                                             |                                                |

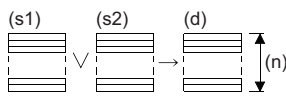
### ■Performing an AND operation on 16-bit block data

| Instruction symbol | Processing details                                                                                                                                             | Reference         |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| BKAND              | Performs an AND operation on the two 16-bit binary data blocks specified.<br> | Page 334 BKAND(P) |
| BKANDP             |                                                                                                                                                                |                   |

### ■Performing an OR operation on 16-bit/32-bit data

| Instruction symbol | Processing details                                                                         | Reference                                     |
|--------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------|
| WOR                | Performs an OR operation on the two sets of 16-bit binary data specified. (Two operands)   | Page 336 WOR(P) [when two operands are set]   |
| WORP               |                                                                                            |                                               |
| WOR                | Performs an OR operation on the two sets of 16-bit binary data specified. (Three operands) | Page 337 WOR(P) [when three operands are set] |
| WORP               |                                                                                            |                                               |
| DOR                | Performs an OR operation on the two sets of 32-bit binary data specified. (Two operands)   | Page 339 DOR(P) [when two operands are set]   |
| DORP               |                                                                                            |                                               |
| DOR                | Performs an OR operation on the two sets of 32-bit binary data specified. (Three operands) | Page 341 DOR(P) [when three operands are set] |
| DORP               |                                                                                            |                                               |

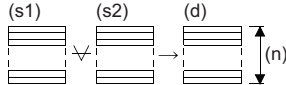
### ■Performing an OR operation on 16-bit block data

| Instruction symbol | Processing details                                                                                                                                              | Reference        |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| BKOR               | Performs an OR operation on the two 16-bit binary data blocks specified.<br> | Page 343 BKOR(P) |
| BKORP              |                                                                                                                                                                 |                  |

### ■Performing an XOR operation on 16-bit/32-bit data

| Instruction symbol | Processing details                                                                          | Reference                                      |
|--------------------|---------------------------------------------------------------------------------------------|------------------------------------------------|
| WXOR               | Performs an XOR operation on the two sets of 16-bit binary data specified. (Two operands)   | Page 345 WXOR(P) [when two operands are set]   |
| WXORP              |                                                                                             |                                                |
| WXOR               | Performs an XOR operation on the two sets of 16-bit binary data specified. (Three operands) | Page 346 WXOR(P) [when three operands are set] |
| WXORP              |                                                                                             |                                                |
| DXOR               | Performs an XOR operation on the two sets of 32-bit binary data specified. (Two operands)   | Page 348 DXOR(P) [when two operands are set]   |
| DXORP              |                                                                                             |                                                |
| DXOR               | Performs an XOR operation on the two sets of 32-bit binary data specified. (Three operands) | Page 350 DXOR(P) [when three operands are set] |
| DXORP              |                                                                                             |                                                |

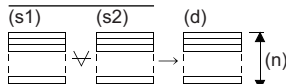
## ■Performing an XOR operation on 16-bit block data

| Instruction symbol | Processing details                                                                | Reference         |
|--------------------|-----------------------------------------------------------------------------------|-------------------|
| BKXOR              | Performs an XOR operation on the two 16-bit binary data blocks specified.         | Page 352 BKXOR(P) |
| BKXORP             |  |                   |

## ■Performing an XNOR operation on 16-bit/32-bit data

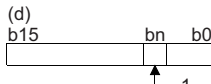
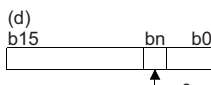
| Instruction symbol | Processing details                                                                           | Reference                                      |
|--------------------|----------------------------------------------------------------------------------------------|------------------------------------------------|
| WXNR               | Performs an XNOR operation on the two sets of 16-bit binary data specified. (Two operands)   | Page 354 WXNR(P) [when two operands are set]   |
| WXNRP              |                                                                                              |                                                |
| WXNR               | Performs an XNOR operation on the two sets of 16-bit binary data specified. (Three operands) | Page 355 WXNR(P) [when three operands are set] |
| WXNRP              |                                                                                              |                                                |
| DXNR               | Performs an XNOR operation on the two sets of 32-bit binary data specified. (Two operands)   | Page 357 DXNR(P) [when two operands are set]   |
| DXNRP              |                                                                                              |                                                |
| DXNR               | Performs an XNOR operation on the two sets of 32-bit binary data specified. (Three operands) | Page 359 DXNR(P) [when three operands are set] |
| DXNRP              |                                                                                              |                                                |

## ■Performing an XNOR operation on 16-bit block data

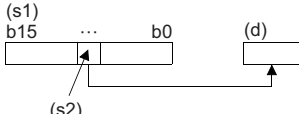
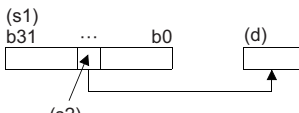
| Instruction symbol | Processing details                                                                 | Reference         |
|--------------------|------------------------------------------------------------------------------------|-------------------|
| BKXNR              | Performs an XNOR operation on the two 16-bit binary data blocks specified.         | Page 361 BKXNR(P) |
| BKXNRP             |  |                   |

## Bit processing instructions

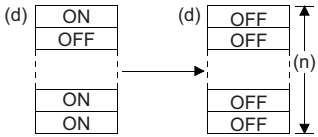
### ■Setting/resetting a bit in the word device

| Instruction symbol | Processing details                                                                  | Reference        |
|--------------------|-------------------------------------------------------------------------------------|------------------|
| BSET               | Sets the 'n'th bit in the specified word device to 1.                               | Page 363 BSET(P) |
| BSETP              |  |                  |
| BRST               | Resets the 'n'th bit in the specified word device to 0.                             | Page 365 BRST(P) |
| BRSTP              |  |                  |

### ■Performing a bit test

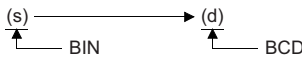
| Instruction symbol | Processing details                                                                  | Reference         |
|--------------------|-------------------------------------------------------------------------------------|-------------------|
| TEST               | Extracts the 'n'th bit in the specified word device.                                | Page 366 TEST(P)  |
| TESTP              |  |                   |
| DTEST              | Extracts the 'n'th bit in the specified double-word device.                         | Page 368 DTEST(P) |
| DTESTP             |  |                   |

## ■Batch-resetting bit devices

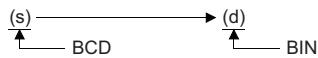
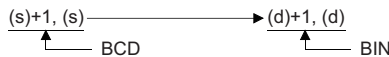
| Instruction symbol | Processing details                                                                | Reference         |
|--------------------|-----------------------------------------------------------------------------------|-------------------|
| BKRST              | Resets the (n) points of bit devices starting from the bit device specified.      | Page 370 BKRST(P) |
| BKRSTP             |  |                   |

## Data conversion instructions

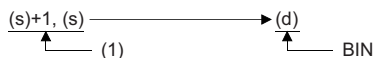
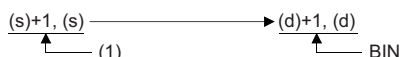
### ■Converting binary data to BCD 4-digit/8-digit data

| Instruction symbol | Processing details                                                                | Reference        |
|--------------------|-----------------------------------------------------------------------------------|------------------|
| BCD                | Converts the specified 16-bit binary data (0 to 9999) to BCD 4-digit data.        | Page 392 BCD(P)  |
| BCDP               |  |                  |
| DBCD               | Converts the specified 32-bit binary data (0 to 99999999) to BCD 8-digit data.    | Page 394 DBCD(P) |
| DBCDP              |  |                  |

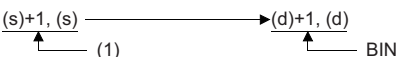
### ■Converting BCD 4-digit/8-digit data to 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                  | Reference        |
|--------------------|-------------------------------------------------------------------------------------|------------------|
| BIN                | Converts the specified BCD 4-digit data (0 to 9999) to 16-bit binary data.          | Page 396 BIN(P)  |
| BINP               |  |                  |
| DBIN               | Converts the specified BCD 8-digit data (0 to 99999999) to 32-bit binary data.      | Page 398 DBIN(P) |
| DBINP              |  |                  |

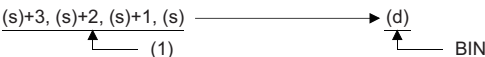
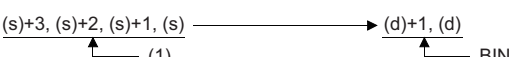
### ■Converting single-precision real number to 16-bit/32-bit signed binary data

| Instruction symbol | Processing details                                                                                            | Reference            |
|--------------------|---------------------------------------------------------------------------------------------------------------|----------------------|
| FLT2INT            | Converts the specified single-precision real number (-32768 to 32767) to 16-bit signed binary data.           | Page 400 FLT2INT(P)  |
| FLT2INTP           | <br>(1) Real number        |                      |
| FLT2DINT           | Converts the specified single-precision real number (-2147483648 to 2147483647) to 32-bit signed binary data. | Page 404 FLT2DINT(P) |
| FLT2DINTP          | <br>(1) Real number        |                      |

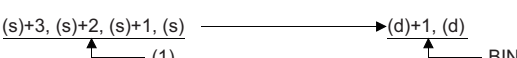
## ■Converting single-precision real number to 16-bit/32-bit unsigned binary data

| Instruction symbol | Processing details                                                                                       | Reference             |
|--------------------|----------------------------------------------------------------------------------------------------------|-----------------------|
| FLT2UINT           | Converts the specified single-precision real number (0 to 65535) to 16-bit unsigned binary data.         | Page 402 FLT2UINT(P)  |
| FLT2UINTP          |  <p>(1) Real number</p> |                       |
| FLT2UDINT          | Converts the specified single-precision real number (0 to 4294967295) to 32-bit unsigned binary data.    | Page 406 FLT2UDINT(P) |
| FLT2UDINTP         |  <p>(1) Real number</p> |                       |

## ■Converting double-precision real number to 16-bit/32-bit signed binary data

| Instruction symbol | Processing details                                                                                            | Reference            |
|--------------------|---------------------------------------------------------------------------------------------------------------|----------------------|
| DBL2INT            | Converts the specified double-precision real number (-32768 to 32767) to 16-bit signed binary data.           | Page 408 DBL2INT(P)  |
| DBL2INTP           |  <p>(1) Real number</p>      |                      |
| DBL2DINT           | Converts the specified double-precision real number (-2147483648 to 2147483647) to 32-bit signed binary data. | Page 412 DBL2DINT(P) |
| DBL2DINTP          |  <p>(1) Real number</p>     |                      |

## ■Converting double-precision real number to 16-bit/32-bit unsigned binary data

| Instruction symbol | Processing details                                                                                         | Reference             |
|--------------------|------------------------------------------------------------------------------------------------------------|-----------------------|
| DBL2UINT           | Converts the specified double-precision real number (0 to 65535) to 16-bit unsigned binary data.           | Page 410 DBL2UINT(P)  |
| DBL2UINTP          |  <p>(1) Real number</p> |                       |
| DBL2UDINT          | Converts the specified double-precision real number (0 to 4294967295) to 32-bit unsigned binary data.      | Page 414 DBL2UDINT(P) |
| DBL2UDINTP         |  <p>(1) Real number</p> |                       |

## ■Converting 16-bit signed binary data to 16-bit/32-bit unsigned binary data

| Instruction symbol | Processing details                                                                                                                                                  | Reference             |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| INT2UINT           | Converts the 16-bit signed binary data in the device specified by (s) to 16-bit unsigned binary data, and stores the converted data in the device specified by (d). | Page 416 INT2UINT(P)  |
| INT2UINTP          |                                                                                                                                                                     |                       |
| INT2UDINT          | Converts the 16-bit signed binary data in the device specified by (s) to 32-bit unsigned binary data, and stores the converted data in the device specified by (d). | Page 420 INT2UDINT(P) |
| INT2UDINTP         |                                                                                                                                                                     |                       |

## ■Converting 16-bit signed binary data to 32-bit signed binary data

| Instruction symbol | Processing details                                                                                                                                                | Reference            |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| INT2DINT           | Converts the 16-bit signed binary data in the device specified by (s) to 32-bit signed binary data, and stores the converted data in the device specified by (d). | Page 418 INT2DINT(P) |
| INT2DINTP          |                                                                                                                                                                   |                      |

## ■Converting 16-bit unsigned binary data to 16-bit/32-bit signed binary data

| Instruction symbol | Processing details                                                                                                                                                  | Reference             |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| UINT2INT           | Converts the 16-bit unsigned binary data in the device specified by (s) to 16-bit signed binary data, and stores the converted data in the device specified by (d). | Page 422 UINT2INT(P)  |
| UINT2INTP          |                                                                                                                                                                     |                       |
| UINT2DINT          | Converts the 16-bit unsigned binary data in the device specified by (s) to 32-bit signed binary data, and stores the converted data in the device specified by (d). | Page 424 UINT2DINT(P) |
| UINT2DINTP         |                                                                                                                                                                     |                       |

## ■Converting 16-bit unsigned binary data to 32-bit unsigned binary data

| Instruction symbol | Processing details                                                                                                                                                    | Reference              |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| UINT2UDINT         | Converts the 16-bit unsigned binary data in the device specified by (s) to 32-bit unsigned binary data, and stores the converted data in the device specified by (d). | Page 426 UINT2UDINT(P) |
| UINT2UDINTP        |                                                                                                                                                                       |                        |

## ■Converting 32-bit signed binary data to 16-bit signed binary data

| Instruction symbol | Processing details                                                                                                                                                | Reference            |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| DINT2INT           | Converts the 32-bit signed binary data in the device specified by (s) to 16-bit signed binary data, and stores the converted data in the device specified by (d). | Page 428 DINT2INT(P) |
| DINT2INTP          |                                                                                                                                                                   |                      |

## ■Converting 32-bit signed binary data to 16-bit/32-bit unsigned binary data

| Instruction symbol | Processing details                                                                                                                                                  | Reference              |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| DINT2UINT          | Converts the 32-bit signed binary data in the device specified by (s) to 16-bit unsigned binary data, and stores the converted data in the device specified by (d). | Page 430 DINT2UINT(P)  |
| DINT2UINTP         |                                                                                                                                                                     |                        |
| DINT2UDINT         | Converts the 32-bit signed binary data in the device specified by (s) to 32-bit unsigned binary data, and stores the converted data in the device specified by (d). | Page 432 DINT2UDINT(P) |
| DINT2UDINTP        |                                                                                                                                                                     |                        |

## ■Converting 32-bit unsigned binary data to 16-bit/32-bit signed binary data

| Instruction symbol | Processing details                                                                                                                                                  | Reference              |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| UDINT2INT          | Converts the 32-bit unsigned binary data in the device specified by (s) to 16-bit signed binary data, and stores the converted data in the device specified by (d). | Page 434 UDINT2INT(P)  |
| UDINT2INTP         |                                                                                                                                                                     |                        |
| UDINT2DINT         | Converts the 32-bit unsigned binary data in the device specified by (s) to 32-bit signed binary data, and stores the converted data in the device specified by (d). | Page 438 UDINT2DINT(P) |
| UDINT2DINTP        |                                                                                                                                                                     |                        |

## ■Converting 32-bit unsigned binary data to 16-bit unsigned binary data

| Instruction symbol | Processing details                                                                                                                                                    | Reference              |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| UDINT2UINT         | Converts the 32-bit unsigned binary data in the device specified by (s) to 16-bit unsigned binary data, and stores the converted data in the device specified by (d). | Page 436 UDINT2UINT(P) |
| UDINT2UINTP        |                                                                                                                                                                       |                        |

## ■Converting 16-bit/32-bit binary data to 16-bit/32-bit binary Gray code data

| Instruction symbol | Processing details                                                                                     | Reference           |
|--------------------|--------------------------------------------------------------------------------------------------------|---------------------|
| GRY                | Converts the specified 16-bit binary data (-32768 to 32767) to 16-bit binary Gray code data.           | Page 440 GRY(P)(U)  |
| GRYP               | <p>Gc: Gray code</p>                                                                                   |                     |
| GRY_U              | Converts the specified 16-bit binary data (0 to 65535) to 16-bit binary Gray code data.                |                     |
| GRYP_U             | <p>Gc: Gray code</p>                                                                                   |                     |
| DGRY               | Converts the specified 32-bit binary data (-2147483648 to 2147483647) to 32-bit binary Gray code data. | Page 442 DGRY(P)(U) |
| DGRYP              | <p>Gc: Gray code</p>                                                                                   |                     |
| DGRY_U             | Converts the specified 32-bit binary data (0 to 4294967295) to 32-bit binary Gray code data.           |                     |
| DGRYP_U            | <p>Gc: Gray code</p>                                                                                   |                     |

## ■Converting 16-bit/32-bit binary Gray code data to 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                     | Reference            |
|--------------------|--------------------------------------------------------------------------------------------------------|----------------------|
| GBIN               | Converts the specified 16-bit binary Gray code data (-32768 to 32767) to 16-bit binary data.           | Page 444 GBIN(P)(U)  |
| GBINP              | <p>Gc: Gray code</p>                                                                                   |                      |
| GBIN_U             | Converts the specified 16-bit binary Gray code data (0 to 65535) to 16-bit binary data.                |                      |
| GBINP_U            | <p>Gc: Gray code</p>                                                                                   |                      |
| DGBIN              | Converts the specified 32-bit binary Gray code data (-2147483648 to 2147483647) to 32-bit binary data. | Page 446 DGBIN(P)(U) |
| DGBINP             | <p>Gc: Gray code</p>                                                                                   |                      |
| DGBIN_U            | Converts the specified 32-bit binary Gray code data (0 to 4294967295) to 32-bit binary data.           |                      |
| DGBINP_U           | <p>Gc: Gray code</p>                                                                                   |                      |

## ■Converting 16-bit binary data block to BCD 4-digit data block

| Instruction symbol | Processing details                                                                                                                                                                     | Reference         |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| BKBCD              | Batch-converts the (n) points of binary data in the device starting from the one specified by (s) to BCD data, and stores the converted data in the device specified by (d) and later. | Page 448 BKBCD(P) |
| BKBCDP             |                                                                                                                                                                                        |                   |

## ■Converting BCD 4-digit block data to 16-bit binary block data

| Instruction symbol | Processing details                                                                                                                                                                     | Reference         |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| BKBIN              | Batch-converts the (n) points of BCD data in the device starting from the one specified by (s) to binary data, and stores the converted data in the device specified by (d) and later. | Page 450 BKBIN(P) |
| BKBINP             |                                                                                                                                                                                        |                   |



## ■Converting decimal ASCII data to 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                                                                               | Reference              |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| DABIN              | Converts the decimal ASCII value in the device specified by (s) to 1-word binary data, and stores the converted data in the word device number specified by (d). | Page 452 DABIN(P)(_U)  |
| DABINP             |                                                                                                                                                                  |                        |
| DABIN_U            |                                                                                                                                                                  |                        |
| DABINP_U           |                                                                                                                                                                  |                        |
| DDABIN             | Converts the decimal ASCII value in the device specified by (s) to 2-word binary data, and stores the converted data in the word device number specified by (d). | Page 455 DDABIN(P)(_U) |
| DDABINP            |                                                                                                                                                                  |                        |
| DDABIN_U           |                                                                                                                                                                  |                        |
| DDABINP_U          |                                                                                                                                                                  |                        |

## ■Converting hexadecimal ASCII data to 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                                                                                   | Reference          |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| HABIN              | Converts the hexadecimal ASCII value in the device specified by (s) to 1-word binary data, and stores the converted data in the word device number specified by (d). | Page 459 HABIN(P)  |
| HABINP             |                                                                                                                                                                      |                    |
| DHABIN             | Converts the hexadecimal ASCII value in the device specified by (s) to 2-word binary data, and stores the converted data in the word device number specified by (d). | Page 462 DHABIN(P) |
| DHABINP            |                                                                                                                                                                      |                    |

## ■Converting decimal ASCII data to BCD 4-digit/8-digit data

| Instruction symbol | Processing details                                                                                                                                            | Reference          |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| DABCD              | Converts the decimal ASCII value in the device specified by (s) to 1-word BCD data, and stores the converted data in the word device number specified by (d). | Page 465 DABCD(P)  |
| DABCDP             |                                                                                                                                                               |                    |
| DDABCD             | Converts the decimal ASCII value in the device specified by (s) to 2-word BCD data, and stores the converted data in the word device number specified by (d). | Page 468 DDABCD(P) |
| DDABCDP            |                                                                                                                                                               |                    |

## ■Converting decimal string data to 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                                                                                                                                    | Reference            |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| VAL                | Converts a string including the decimal point in the device specified by (s) to 1-word binary data and the number of decimal positions, and stores the converted data in the device areas specified by (d1) and (d2). | Page 471 VAL(P)(_U)  |
| VALP               |                                                                                                                                                                                                                       |                      |
| VAL_U              |                                                                                                                                                                                                                       |                      |
| VALP_U             |                                                                                                                                                                                                                       |                      |
| DVAL               | Converts a string including the decimal point in the device specified by (s) to 2-word binary data and the number of decimal positions, and stores the converted data in the device areas specified by (d1) and (d2). | Page 474 DVAL(P)(_U) |
| DVALP              |                                                                                                                                                                                                                       |                      |
| DVAL_U             |                                                                                                                                                                                                                       |                      |
| DVALP_U            |                                                                                                                                                                                                                       |                      |

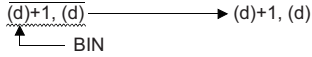
## ■Converting hexadecimal ASCII to hexadecimal binary data

| Instruction symbol | Processing details                                                                                                                                                                                                            | Reference           |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| ASC2INT            | Converts the hexadecimal ASCII data in the word device specified by (s) and later to binary data by the number of characters specified by (n), and stores the converted data in the device number specified by (d) and later. | Page 477 ASC2INT(P) |
| ASC2INTP           |                                                                                                                                                                                                                               |                     |

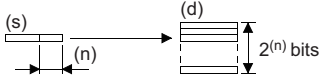
## ■Converting single-precision real number to BCD format data

| Instruction symbol | Processing details                                                                                                                                                                                 | Reference        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| EMOD               | Converts the 32-bit floating-point data in the device specified by (s1) to BCD of the number of decimal positions specified by (s2), and stores the converted data in the device specified by (d). | Page 479 EMOD(P) |
| EMODP              |                                                                                                                                                                                                    |                  |

## ■Two's complement of 16-bit/32-bit binary data (sign inversion)

| Instruction symbol | Processing details                                                                | Reference        |
|--------------------|-----------------------------------------------------------------------------------|------------------|
| NEG                | Inverts the sign of 16-bit binary device.                                         | Page 481 NEG(P)  |
| NEGP               |  |                  |
| DNEG               | Inverts the sign of 32-bit binary device.                                         | Page 482 DNEG(P) |
| DNEGP              |  |                  |

## ■Decoding 8-bit data to 256-bit data

| Instruction symbol | Processing details                                                                | Reference        |
|--------------------|-----------------------------------------------------------------------------------|------------------|
| DECO               | Decodes the lower (n) bits of the specified device.                               | Page 483 DECO(P) |
| DECOP              |  |                  |

## ■Encoding 256-bit data to 8-bit data

| Instruction symbol | Processing details                                                                | Reference        |
|--------------------|-----------------------------------------------------------------------------------|------------------|
| ENCO               | Encodes the bit data of 'n'th power of 2.                                         | Page 485 ENCO(P) |
| ENCOP              |  |                  |

## ■Decoding data to seven-segment display data

| Instruction symbol | Processing details                                                                                               | Reference       |
|--------------------|------------------------------------------------------------------------------------------------------------------|-----------------|
| SEG                | Decodes the data consisting of 0 to F specified by the lower 4 bits of the device to seven-segment display data. | Page 487 SEG(P) |
| SEGP               |                               |                 |

## ■Separating data in units of 4 bits

| Instruction symbol | Processing details                                                                                       | Reference       |
|--------------------|----------------------------------------------------------------------------------------------------------|-----------------|
| DIS                | Separates the 16-bit in the device specified by (s) in units of 4 bits, and stores the separated data in | Page 490 DIS(P) |
| DISP               | the (n) points of 4 low-order bits in the device starting from the one specified by (d). (n<4)           |                 |

## ■Combining data in units of 4 bits

| Instruction symbol | Processing details                                                                                    | Reference       |
|--------------------|-------------------------------------------------------------------------------------------------------|-----------------|
| UNI                | Adds the (n) points of 4 low-order bit data in the device starting from the one specified by (s), and | Page 492 UNI(P) |
| UNIP               | stores the connected data in the device specified by (d). (n<4)                                       |                 |

## ■Separating/combining data in units of bits

| Instruction symbol | Processing details                                                                                           | Reference        |
|--------------------|--------------------------------------------------------------------------------------------------------------|------------------|
| NDIS               | Separates the data in the device, specified by (s1) and later, to the bits in the device specified by        | Page 494 NDIS(P) |
| NDISP              | (s2) and later, and stores the separated data in order in the device starting from the one specified by (d). |                  |
| NUNI               | Connects the data in the device specified by (s1) and later, in units of bits in the device specified by     | Page 496 NUNI(P) |
| NUNIP              | (s2) and later, and stores the connected data in order in the device starting from the one specified by (d). |                  |

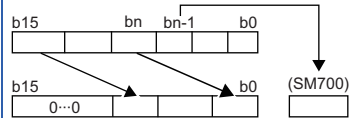
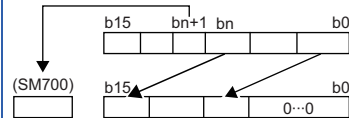
## ■ Separating/combining data in units of bytes

| Instruction symbol | Processing details                                                                                                                                                                                 | Reference        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| WTOB               | Converts the (n) points of 16 bit data in the device specified by (s) in units of 8 bits, and stores the converted data in order in the device starting from the one specified by (d).             | Page 498 WTOB(P) |
| WTOBP              |                                                                                                                                                                                                    |                  |
| BTOW               | Connects 8 low-order bits of the (n) points of 16 bit data in the device specified by (s) to 16 bits, and stores the connected data in order in the device starting from the one specified by (d). | Page 500 BTOW(P) |
| BTOWP              |                                                                                                                                                                                                    |                  |

## Shift instructions

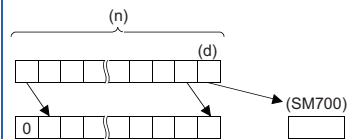
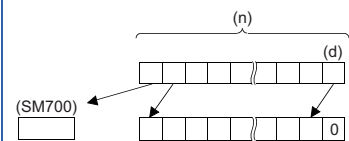
### ■ Shifting 16-bit binary data to the right/left by n bit(s)

| Instruction symbol | Processing details                                                                                                  | Reference       |
|--------------------|---------------------------------------------------------------------------------------------------------------------|-----------------|
| SFR                | Shifts the 16-bit binary data in the specified device to the right. In the empty area after the shift, 0 is stored. | Page 372 SFR(P) |
| SFRP               |                                                                                                                     |                 |
| SFL                | Shifts the 16-bit binary data in the specified device to the left. In the empty area after the shift, 0 is stored.  | Page 374 SFL(P) |
| SFLP               |                                                                                                                     |                 |

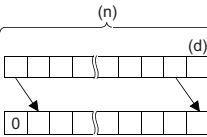
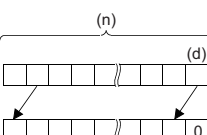


### ■ Shifting n-bit data to the right/left by one bit

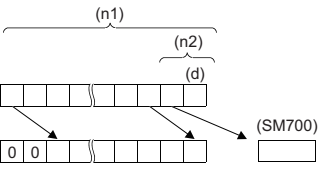
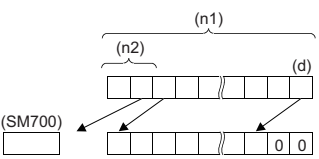
| Instruction symbol | Processing details                                                                                                                      | Reference        |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------------|
| BSFR               | Shifts the n points of data starting from the specified device to the right by one bit. In the empty area after the shift, 0 is stored. | Page 376 BSFR(P) |
| BSFRP              |                                                                                                                                         |                  |
| BSFL               | Shifts the n points of data starting from the specified device to the left by one bit. In the empty area after the shift, 0 is stored.  | Page 378 BSFL(P) |
| BSFLP              |                                                                                                                                         |                  |



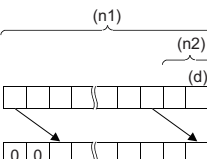
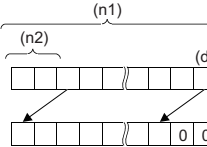
## ■Shifting n-word data to the right/left by one word

| Instruction symbol | Processing details                                                                                                                                                                                                            | Reference        |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| DSFR<br>DSFRP      | Shifts the n points of data starting from the specified device to the right by one word. In the empty area after the shift, 0 is stored.<br> | Page 380 DSFR(P) |
| DSFL<br>DSFLP      | Shifts the n points of data starting from the specified device to the left by one word. In the empty area after the shift, 0 is stored.<br>  | Page 382 DSFL(P) |

## ■Shifting n-bit data to the right/left by n bit(s)

| Instruction symbol | Processing details                                                                                                                                                                                                       | Reference         |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| SFTBR<br>SFTBRP    | Shifts the n-bit data starting from the specified device to the right by n bit(s). In the empty area after the shift, 0 is stored.<br> | Page 384 SFTBR(P) |
| SFTBL<br>SFTBLP    | Shifts the n-bit data starting from the specified device to the left by n bit(s). In the empty area after the shift, 0 is stored.<br> | Page 386 SFTBL(P) |

## ■Shifting n-word data to the right/left by n word(s)

| Instruction symbol | Processing details                                                                                                                                                                                                          | Reference         |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| SFTWR<br>SFTWRP    | Shifts the n-word data starting from the specified device to the right by n word(s). In the empty area after the shift, 0 is stored.<br> | Page 388 SFTWR(P) |
| SFTWL<br>SFTWLP    | Shifts the n-word data starting from the specified device to the left by n word(s). In the empty area after the shift, 0 is stored.<br>  | Page 390 SFTWL(P) |

## Data transfer instructions

### ■Transferring 16-bit/32-bit binary data

| Instruction symbol | Processing details                                        | Reference        |
|--------------------|-----------------------------------------------------------|------------------|
| MOV                | Transfers the 16-bit binary data in the device specified. | Page 502 MOV(P)  |
| MOVP               | (s) $\longrightarrow$ (d)                                 |                  |
| DMOV               | Transfers the 32-bit binary data in the device specified. | Page 504 DMOV(P) |
| DMOVP              | (s)+1, (s) $\longrightarrow$ (d)+1, (d)                   |                  |

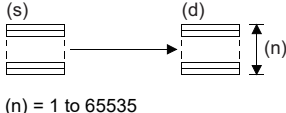
### ■Inverting and transferring 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                    | Reference        |
|--------------------|---------------------------------------------------------------------------------------|------------------|
| CML                | Inverts the specified 16-bit binary data bit by bit, and transfers the inverted data. | Page 506 CML(P)  |
| CMLP               | (s) $\longrightarrow$ (d)                                                             |                  |
| DCML               | Inverts the specified 32-bit binary data bit by bit, and transfers the inverted data. | Page 508 DCML(P) |
| DCMLP              | (s)+1, (s) $\longrightarrow$ (d)+1, (d)                                               |                  |

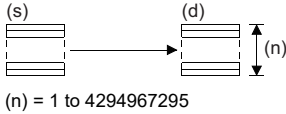
### ■Inverting and transferring 1-bit data

| Instruction symbol | Processing details                                                                                                | Reference        |
|--------------------|-------------------------------------------------------------------------------------------------------------------|------------------|
| CMLB               | Inverts the bit data in the device specified by (s), and stores the inverted data in the device specified by (d). | Page 510 CMLB(P) |
| CMLBP              |                                                                                                                   |                  |

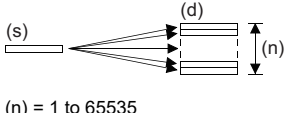
### ■Transferring 16-bit binary data block (16 bits)

| Instruction symbol | Processing details                                                                                      | Reference        |
|--------------------|---------------------------------------------------------------------------------------------------------|------------------|
| BMOV               | Batch-transfers the (n) points of 16-bit binary data starting from the device specified.                | Page 512 BMOV(P) |
| BMOVP              | <br>(n) = 1 to 65535 |                  |

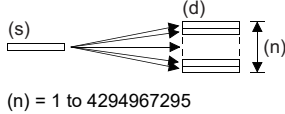
### ■Transferring 16-bit binary data block (32 bits)

| Instruction symbol | Processing details                                                                                           | Reference         |
|--------------------|--------------------------------------------------------------------------------------------------------------|-------------------|
| BMOVL              | Batch-transfers the (n) points of 16-bit binary data starting from the device specified.                     | Page 514 BMOVL(P) |
| BMOVLP             | <br>(n) = 1 to 4294967295 |                   |

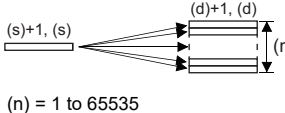
### ■Transferring the same 16-bit binary data block (16 bits)

| Instruction symbol | Processing details                                                                                      | Reference        |
|--------------------|---------------------------------------------------------------------------------------------------------|------------------|
| FMOV               | Transfers 16-bit binary data to the (n) points starting from the device specified.                      | Page 516 FMOV(P) |
| FMOVP              | <br>(n) = 1 to 65535 |                  |

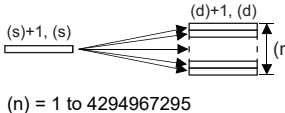
## ■Transferring the same 16-bit binary data block (32 bits)

| Instruction symbol | Processing details                                                                                                                                                                                       | Reference         |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| FMOVL              | <p>Transfers 16-bit binary data to the (n) points starting from the device specified.</p>  <p>(n) = 1 to 4294967295</p> | Page 518 FMOVL(P) |
| FMOVLP             |                                                                                                                                                                                                          |                   |

## ■Transferring the same 32-bit binary data block (16 bits)

| Instruction symbol | Processing details                                                                                                                                                                                  | Reference         |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| DFMOV              | <p>Transfers 32-bit binary data to the (n) points starting from the device specified.</p>  <p>(n) = 1 to 65535</p> | Page 520 DFMOV(P) |
| DFMOVLP            |                                                                                                                                                                                                     |                   |

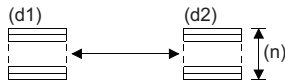
## ■Transferring the same 32-bit binary data block (32 bits)

| Instruction symbol | Processing details                                                                                                                                                                                       | Reference          |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| DFMOVL             | <p>Transfers 32-bit binary data to the (n) points starting from the device specified.</p>  <p>(n) = 1 to 4294967295</p> | Page 522 DFMOVL(P) |
| DFMOVLP            |                                                                                                                                                                                                          |                    |

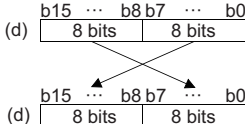
## ■Exchanging 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                                                     | Reference        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------|
| XCH                | <p>Exchanges the 16-bit binary data specified.</p>  | Page 524 XCH(P)  |
| XCHP               |                                                                                                                                        |                  |
| DXCH               | <p>Exchanges the 32-bit binary data specified.</p>  | Page 525 DXCH(P) |
| DXCHP              |                                                                                                                                        |                  |

## ■Exchanging 16-bit binary block data

| Instruction symbol | Processing details                                                                                                                                                             | Reference        |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| BXCH               | <p>Exchanges the (n) points of 16-bit binary data starting from the devices specified.</p>  | Page 526 BXCH(P) |
| BXCHP              |                                                                                                                                                                                |                  |

## ■Exchanging the upper and lower bytes of 16-bit binary data

| Instruction symbol | Processing details                                                                                                                                       | Reference        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| SWAP               | <p>Exchanges upper and lower 8-bit data in the specified device.</p>  | Page 528 SWAP(P) |
| SWAPP              |                                                                                                                                                          |                  |

## ■Exchanging the upper and lower bytes of 32-bit binary data

| Instruction symbol | Processing details                                                                                                                                                                                                                                                     | Reference         |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| DSWAP              | Exchanges upper and lower 8-bit data in the specified device.<br><div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>(d)+1</p> </div> <div style="text-align: center;"> <p>(d)</p> </div> </div> | Page 529 DSWAP(P) |
| DSWAPP             |                                                                                                                                                                                                                                                                        |                   |

## ■Transferring 1-bit data

| Instruction symbol | Processing details                                                                 | Reference        |
|--------------------|------------------------------------------------------------------------------------|------------------|
| MOVB               | Stores the bit data in the device specified by (s) in the device specified by (d). | Page 530 MOVB(P) |
| MOVBP              |                                                                                    |                  |

## ■Transferring n-bit data

| Instruction symbol | Processing details                                                                                                                                                                  | Reference           |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| BLKMOVB            | Batch-transfers the (n) points of bit data in the device starting from the one specified by (s) to the (n) points of bit data in the device starting from the one specified by (d). | Page 531 BLKMOVB(P) |
| BLKMOVBP           |                                                                                                                                                                                     |                     |

## 6.3 Application Instructions

### Program control

#### Program branch instructions

##### ■Pointer branch

| Instruction symbol | Processing details                                                                                             | Reference             |
|--------------------|----------------------------------------------------------------------------------------------------------------|-----------------------|
| CJ                 | Executes the program specified by the pointer number within the same program file.                             | Page 534 CJ, SCJ, JMP |
| SCJ                | Executes the program specified by the pointer number within the same program file starting with the next scan. |                       |
| JMP                | Unconditionally executes the program specified by the pointer number within the same program file.             |                       |

##### ■Jumping to END

| Instruction symbol | Processing details                                                          | Reference      |
|--------------------|-----------------------------------------------------------------------------|----------------|
| GOEND              | Invokes a jump to the FEND or END instruction within the same program file. | Page 537 GOEND |

#### Program execution control instructions

##### ■Disabling/enabling interrupt programs

| Instruction symbol | Processing details                            | Reference       |
|--------------------|-----------------------------------------------|-----------------|
| DI                 | Disables the execution of interrupt programs. | Page 538 DI, EI |
| EI                 | Clears the interrupt disabled state.          |                 |

##### ■Disabling the interrupt program with specified priority or lower

| Instruction symbol | Processing details                                                                              | Reference   |
|--------------------|-------------------------------------------------------------------------------------------------|-------------|
| DI                 | This instruction disables execution of interrupt programs with the specified priority or lower. | Page 542 DI |

##### ■Interrupt program mask

| Instruction symbol | Processing details                                                                                      | Reference      |
|--------------------|---------------------------------------------------------------------------------------------------------|----------------|
| IMASK              | Enables or disables the execution of the interrupt program with the specified interrupt pointer number. | Page 547 IMASK |

##### ■Disabling/enabling the specified interrupt pointer

| Instruction symbol | Processing details                                                                                      | Reference       |
|--------------------|---------------------------------------------------------------------------------------------------------|-----------------|
| SIMASK             | Enables or disables the execution of the interrupt program with the specified interrupt pointer number. | Page 549 SIMASK |

##### ■Returning from the interrupt program

| Instruction symbol | Processing details                                           | Reference     |
|--------------------|--------------------------------------------------------------|---------------|
| IRET               | Indicates the end of the processing of an interrupt program. | Page 551 IRET |

##### ■Resetting the watchdog timer

| Instruction symbol | Processing details         | Reference       |
|--------------------|----------------------------|-----------------|
| WDT                | Resets the watchdog timer. | Page 552 WDT(P) |
| WDTP               |                            |                 |



## Structure creation instructions

### ■Performing the FOR to NEXT instruction loop

| Instruction symbol | Processing details                                     | Reference          |
|--------------------|--------------------------------------------------------|--------------------|
| FOR                | Executes the processing between FOR to NEXT (n) times. | Page 553 FOR, NEXT |
| NEXT               |                                                        |                    |

### ■Forcibly terminating the FOR to NEXT instruction loop

| Instruction symbol | Processing details                                                                                                                                                           | Reference         |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| BREAK              | These instructions forcibly terminate the loop processing between the FOR and NEXT instructions, and pass the control to the processing of FOR to NEXT instruction or later. | Page 556 BREAK(P) |
| BREAKP             |                                                                                                                                                                              |                   |

### ■Calling a subroutine program

| Instruction symbol | Processing details                                                                                                                                                   | Reference        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| CALL               | Executes a subroutine program specified by (P) when the input condition is met.<br>(For (s1) to (s5), specify the arguments to be passed to the subroutine program.) | Page 558 CALL(P) |
| CALLP              |                                                                                                                                                                      |                  |

### ■Returning from the subroutine program called

| Instruction symbol | Processing details                         | Reference    |
|--------------------|--------------------------------------------|--------------|
| RET                | Indicates the end of a subroutine program. | Page 564 RET |

### ■Calling a subroutine program and turning the output off

| Instruction symbol | Processing details                                                                                                                                                                                       | Reference         |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| FCALL              | Performs non-execution processing of the subroutine program specified by (P) when the input conditions are not met.<br>(For (s1) to (s5), specify the arguments to be passed to the subroutine program.) | Page 565 FCALL(P) |
| FCALLP             |                                                                                                                                                                                                          |                   |

### ■Calling a subroutine program in the specified program file

| Instruction symbol | Processing details                                                                                                                                                                                | Reference         |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| ECALL              | Executes the subroutine program specified by (P) of the specified program when the input conditions are met.<br>(For (s1) to (s5), specify the arguments to be passed to the subroutine program.) | Page 571 ECALL(P) |
| ECALLP             |                                                                                                                                                                                                   |                   |

### ■Calling a subroutine program in the specified program file and turning the output off

| Instruction symbol | Processing details                                                                                                                                                                                                             | Reference          |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| EFCALL             | Performs non-execution processing of the subroutine program specified by (P) of the specified program when the input conditions are not met. (For (s1) to (s5), specify the arguments to be passed to the subroutine program.) | Page 578 EFCALL(P) |
| EFCALLP            |                                                                                                                                                                                                                                |                    |

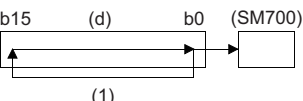
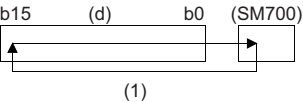
### ■Calling a subroutine program

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                         | Reference      |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| XCALL              | Executes a subroutine program specified by (P) when the input condition is met.<br>Perform non-execution processing of the subroutine program specified by (P) when the input conditions are not met.<br>(For (s1) to (s5), specify the arguments to be passed to the subroutine program.) | Page 583 XCALL |

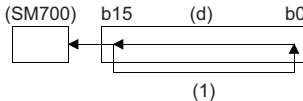
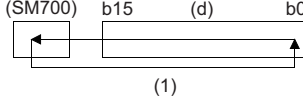
# Data processing

## Rotation instructions

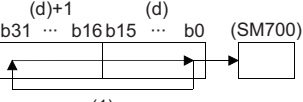
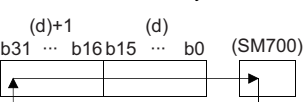
### ■Rotating 16-bit binary data to the right

| Instruction symbol | Processing details                                                                                                      | Reference               |
|--------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------|
| ROR                | Rotates the 16-bit binary data to the right by (n) bit(s) (not including the carry flag).                               | Page 588 ROR(P), RCR(P) |
| RORP               |  <p>(1) Right rotation by (n) bits</p> |                         |
| RCR                | Rotates the 16-bit binary data to the right by (n) bit(s) (including the carry flag).                                   |                         |
| RCRP               |  <p>(1) Right rotation by (n) bits</p> |                         |

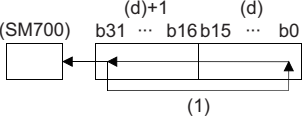
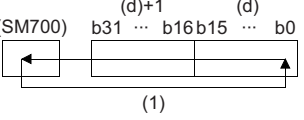
### ■Rotating 16-bit binary data to the left

| Instruction symbol | Processing details                                                                                                       | Reference               |
|--------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------|
| ROL                | Rotates the 16-bit binary data to the left by (n) bit(s) (not including the carry flag).                                 | Page 591 ROL(P), RCL(P) |
| ROLP               |  <p>(1) Left rotation by (n) bits</p>  |                         |
| RCL                | Rotates the 16-bit binary data to the left by (n) bit(s) (including the carry flag).                                     |                         |
| RCLP               |  <p>(1) Left rotation by (n) bits</p> |                         |

### ■Rotating 32-bit binary data to the right

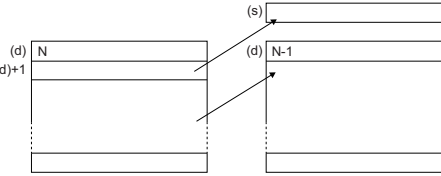
| Instruction symbol | Processing details                                                                                                        | Reference                 |
|--------------------|---------------------------------------------------------------------------------------------------------------------------|---------------------------|
| DROR               | Rotates the 32-bit binary data to the right by (n) bit(s) (not including the carry flag).                                 | Page 594 DROR(P), DRCR(P) |
| DRORP              |  <p>(1) Right rotation by (n) bits</p> |                           |
| DRCR               | Rotates the 32-bit binary data to the right by (n) bit(s) (including the carry flag).                                     |                           |
| DRCRP              |  <p>(1) Right rotation by (n) bits</p> |                           |

## ■Rotating 32-bit binary data to the left

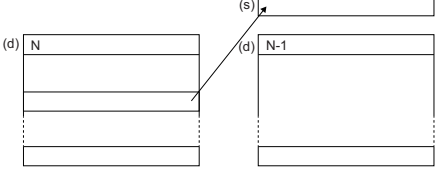
| Instruction symbol | Processing details                                                                                                     | Reference                 |
|--------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------|
| DROL               | Rotates the 32-bit binary data to the left by (n) bit(s) (not including the carry flag).                               | Page 596 DROL(P), DRCL(P) |
| DROLP              |  <p>(1) Left rotation by (n) bits</p> |                           |
| DRCL               | Rotates the 32-bit binary data to the left by (n) bit(s) (including the carry flag).                                   |                           |
| DRCLP              |  <p>(1) Left rotation by (n) bits</p> |                           |

## Data table operation instructions

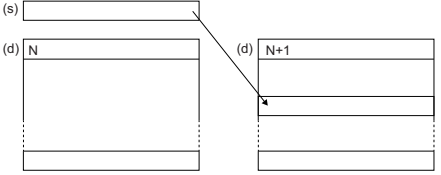
### ■Reading the oldest data from the data table

| Instruction symbol | Processing details                                                                                          | Reference        |
|--------------------|-------------------------------------------------------------------------------------------------------------|------------------|
| FIFR               | Stores the data first stored in the table in the specified device.                                          | Page 598 FIFR(P) |
| FIFRP              |  <p>N: Number of data</p> |                  |

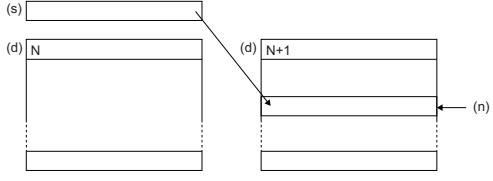
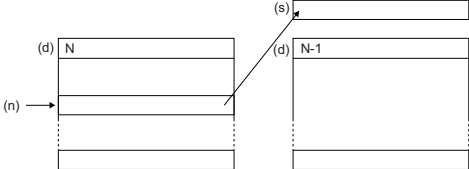
### ■Reading the newest data from the data table

| Instruction symbol | Processing details                                                                                           | Reference        |
|--------------------|--------------------------------------------------------------------------------------------------------------|------------------|
| FPOP               | Stores the data last stored in the table in the specified device.                                            | Page 600 FPOP(P) |
| FPOPP              |  <p>N: Number of data</p> |                  |

### ■Writing data to the data table

| Instruction symbol | Processing details                                                                                           | Reference        |
|--------------------|--------------------------------------------------------------------------------------------------------------|------------------|
| FIFW               | Stores 16-bit binary data to the specified data table.                                                       | Page 602 FIFW(P) |
| FIFWP              |  <p>N: Number of data</p> |                  |

## ■Inserting/deleting data to/from the data table

| Instruction symbol | Processing details                                                                                         | Reference        |
|--------------------|------------------------------------------------------------------------------------------------------------|------------------|
| FINS               | Inserts 16-bit binary data to the (n)th position in the specified data table.                              | Page 604 FINS(P) |
| FINSP              |  <p>N: Number of data</p> |                  |
| FDEL               | Deletes the data at the (n)th position in the data table.                                                  | Page 606 FDEL(P) |
| FDELP              |  <p>N: Number of data</p> |                  |

## Reading/writing data instructions

### ■Reading data from the data memory

| Instruction symbol | Processing details                                           | Reference           |
|--------------------|--------------------------------------------------------------|---------------------|
| S.DEVLD            | Reads data from the device data storage file in data memory. | Page 609 S(P).DEVLD |
| SP.DEVLD           |                                                              |                     |

### ■Writing data to the data memory

| Instruction symbol | Processing details                                                                            | Reference         |
|--------------------|-----------------------------------------------------------------------------------------------|-------------------|
| SP.DEVST           | Writes the specified number of points of data to the device data storage file in data memory. | Page 611 SP.DEVST |

## File operation instructions

### ■Reading data from the specified file

| Instruction symbol | Processing details                  | Reference         |
|--------------------|-------------------------------------|-------------------|
| SP.FREAD           | Reads data from the specified file. | Page 614 SP.FREAD |

### ■Writing data to the specified file

| Instruction symbol | Processing details                 | Reference          |
|--------------------|------------------------------------|--------------------|
| SP.FWRITE          | Writes data to the specified file. | Page 630 SP.FWRITE |

### ■Deleting the specified file

| Instruction symbol | Processing details                    | Reference           |
|--------------------|---------------------------------------|---------------------|
| SP.FDELETE         | Deletes the specified file or folder. | Page 644 SP.FDELETE |

### ■Copying the specified file

| Instruction symbol | Processing details                   | Reference         |
|--------------------|--------------------------------------|-------------------|
| SP.FCOPY           | Copies the specified file or folder. | Page 647 SP.FCOPY |

### ■Moving the specified file

| Instruction symbol | Processing details                  | Reference         |
|--------------------|-------------------------------------|-------------------|
| SP.FMOVE           | Moves the specified file or folder. | Page 652 SP.FMOVE |

### ■Renaming the specified file

| Instruction symbol | Processing details                    | Reference           |
|--------------------|---------------------------------------|---------------------|
| SP.FRENAME         | Renames the specified file or folder. | Page 657 SP.FRENAME |

### ■Acquiring the status of the specified file

| Instruction symbol | Processing details                                   | Reference           |
|--------------------|------------------------------------------------------|---------------------|
| SP.FSTATUS         | Acquires the status of the specified file or folder. | Page 660 SP.FSTATUS |

## Data control instructions

### ■Upper and lower limit control of 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                                         | Reference              |
|--------------------|----------------------------------------------------------------------------------------------------------------------------|------------------------|
| LIMIT              | Controls the output value depending on whether the specified 16-bit binary bit value is within the upper and lower limits. | Page 664 LIMIT(P)(_U)  |
| LIMITP             |                                                                                                                            |                        |
| LIMIT_U            |                                                                                                                            |                        |
| LIMITP_U           |                                                                                                                            |                        |
| DLIMIT             | Controls the output value depending on whether the specified 32-bit binary bit value is within the upper and lower limits. | Page 666 DLIMIT(P)(_U) |
| DLIMITP            |                                                                                                                            |                        |
| DLIMIT_U           |                                                                                                                            |                        |
| DLIMITP_U          |                                                                                                                            |                        |

## ■Dead band control of 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                                                          | Reference             |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| BAND               | Controls the output value depending on whether the specified 16-bit binary bit value is within the upper and lower limits of the dead band. | Page 668 BAND(P)(_U)  |
| BANDP              |                                                                                                                                             |                       |
| BAND_U             |                                                                                                                                             |                       |
| BANDP_U            |                                                                                                                                             |                       |
| DBAND              | Controls the output value depending on whether the specified 32-bit binary bit value is within the upper and lower limits of the dead band. | Page 670 DBAND(P)(_U) |
| DBANDP             |                                                                                                                                             |                       |
| DBAND_U            |                                                                                                                                             |                       |
| DBANDP_U           |                                                                                                                                             |                       |

## ■Zone control of 16-bit/32-bit binary data

| Instruction symbol | Processing details                                              | Reference             |
|--------------------|-----------------------------------------------------------------|-----------------------|
| ZONE               | Adds a bias value to the specified input value (16-bit binary). | Page 672 ZONE(P)(_U)  |
| ZONEP              |                                                                 |                       |
| ZONE_U             |                                                                 |                       |
| ZONEP_U            |                                                                 |                       |
| DZONE              | Adds a bias value to the specified input value (32-bit binary). | Page 674 DZONE(P)(_U) |
| DZONEP             |                                                                 |                       |
| DZONE_U            |                                                                 |                       |
| DZONEP_U           |                                                                 |                       |

## ■Scaling 16-bit/32-bit binary data (point coordinates)

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                                                                          | Reference            |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| SCL                | Scales the scaling conversion data (16-bit data) in the device specified by (s2) on the basis of the input value in the device specified by (s1), and stores the operation result in the device specified by (d).<br>Scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later. | Page 676 SCL(P)(_U)  |
| SCLP               |                                                                                                                                                                                                                                                                                                                                             |                      |
| SCL_U              |                                                                                                                                                                                                                                                                                                                                             |                      |
| SCLP_U             |                                                                                                                                                                                                                                                                                                                                             |                      |
| DSCL               | Scales the scaling conversion data (32-bit data) in the device specified by (s2) on the basis of the input value in the device specified by (s1), and stores the operation result in the device specified by (d).<br>Scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later. | Page 679 DSCL(P)(_U) |
| DSCLP              |                                                                                                                                                                                                                                                                                                                                             |                      |
| DSCL_U             |                                                                                                                                                                                                                                                                                                                                             |                      |
| DSCLP_U            |                                                                                                                                                                                                                                                                                                                                             |                      |

## ■Scaling 16-bit/32-bit binary data (XY coordinates)

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                                                                          | Reference             |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| SCL2               | Scales the scaling conversion data (16-bit data) in the device specified by (s2) on the basis of the input value in the device specified by (s1), and stores the operation result in the device specified by (d).<br>Scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later. | Page 682 SCL2(P)(_U)  |
| SCL2P              |                                                                                                                                                                                                                                                                                                                                             |                       |
| SCL2_U             |                                                                                                                                                                                                                                                                                                                                             |                       |
| SCL2P_U            |                                                                                                                                                                                                                                                                                                                                             |                       |
| DSCL2              | Scales the scaling conversion data (32-bit data) in the device specified by (s2) on the basis of the input value in the device specified by (s1), and stores the operation result in the device specified by (d).<br>Scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later. | Page 684 DSCL2(P)(_U) |
| DSCL2P             |                                                                                                                                                                                                                                                                                                                                             |                       |
| DSCL2_U            |                                                                                                                                                                                                                                                                                                                                             |                       |
| DSCL2P_U           |                                                                                                                                                                                                                                                                                                                                             |                       |

## Data processing instructions

### ■Searching 16-bit/32-bit binary data

| Instruction symbol    | Processing details                                                                                                                                                         | Reference            |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| SERDATA<br>SERDATAP   | <p>Searches the (n) points in the 16-bit binary data specified by (s2) for the 16-bit binary data specified by (s1).</p> <p>(d): Location<br/>(d)+1: Number of matches</p> | Page 686 SERDATA(P)  |
| DSERDATA<br>DSERDATAP | <p>Searches the (n) points in the 32-bit binary data specified by (s2) for the 32-bit binary data specified by (s1).</p> <p>(d): Location<br/>(d)+1: Number of matches</p> | Page 688 DSERDATA(P) |

### ■Searching 16-bit/32-bit binary data (minimum, match, maximum)

| Instruction symbol | Processing details                                                                                                                                                                  | Reference          |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| SERMM<br>SERMMP    | <p>Searches the (n) points in the 16-bit binary data specified by (s1) for the same data as the 16-bit binary data specified by (s2), the minimum value, and the maximum value.</p> | Page 690 SERMM(P)  |
| DSERMM<br>DSERMMP  | <p>Searches the (n) points in the 32-bit binary data specified by (s1) for the same data as the 32-bit binary data specified by (s2), the minimum value, and the maximum value.</p> | Page 692 DSERMM(P) |

### ■Checking 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                                            | Reference        |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------|------------------|
| SUM<br>SUMP        | <p>Stores the total number of "1" bits in the 16-bit binary data stored in the specified device.</p> <p>(d): Number of 1s</p> | Page 694 SUM(P)  |
| DSUM<br>DSUMP      | <p>Stores the total number of "1" bits in the 32-bit binary data stored in the specified device.</p> <p>(d): Number of 1s</p> | Page 695 DSUM(P) |

## ■Searching for the maximum value of 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                                                               | Reference            |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| MAX                | Searches the (n) points of data in the device specified by (s) in units of 16 bits, and stores the maximum value in the device specified by (d). | Page 696 MAX(P)(_U)  |
| MAXP               |                                                                                                                                                  |                      |
| MAX_U              |                                                                                                                                                  |                      |
| MAXP_U             |                                                                                                                                                  |                      |
| DMAX               | Searches the (n) points of data in the device specified by (s) in units of 32 bits, and stores the maximum value in the device specified by (d). | Page 698 DMAX(P)(_U) |
| DMAXP              |                                                                                                                                                  |                      |
| DMAX_U             |                                                                                                                                                  |                      |
| DMAXP_U            |                                                                                                                                                  |                      |

## ■Searching for the minimum value of 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                                                               | Reference            |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| MIN                | Searches the (n) points of data in the device specified by (s) in units of 16 bits, and stores the minimum value in the device specified by (d). | Page 700 MIN(P)(_U)  |
| MINP               |                                                                                                                                                  |                      |
| MIN_U              |                                                                                                                                                  |                      |
| MINP_U             |                                                                                                                                                  |                      |
| DMIN               | Searches the (n) points of data in the device specified by (s) in units of 32 bits, and stores the minimum value in the device specified by (d). | Page 702 DMIN(P)(_U) |
| DMINP              |                                                                                                                                                  |                      |
| DMIN_U             |                                                                                                                                                  |                      |
| DMINP_U            |                                                                                                                                                  |                      |

## ■Sorting 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                                      | Reference           |
|--------------------|-------------------------------------------------------------------------------------------------------------------------|---------------------|
| SORTD              | Sorts the (n) points of data in the device specified by (s1) in units of 16 bits.<br>("n)×((n)-1)÷2" scanning required) | Page 704 SORTD(_U)  |
| SORTD_U            |                                                                                                                         |                     |
| DSORTD             | Sorts the (n) points of data in the device specified by (s1) in units of 32 bits.<br>("n)×((n)-1)÷2" scanning required) | Page 706 DSORTD(_U) |
| DSORTD_U           |                                                                                                                         |                     |

## ■Adding 16-bit binary data

| Instruction symbol | Processing details                                                                                                                                    | Reference            |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| WSUM               | Adds the (n) points of 16-bit binary data in the device starting from the one specified by (s), and stores the result in the device specified by (d). | Page 708 WSUM(P)(_U) |
| WSUM_U             |                                                                                                                                                       |                      |
| WSUMP              |                                                                                                                                                       |                      |
| WSUMP_U            |                                                                                                                                                       |                      |

## ■Adding 32-bit binary data

| Instruction symbol | Processing details                                                                                                                                    | Reference             |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| DWSUM              | Adds the (n) points of 32-bit binary data in the device starting from the one specified by (s), and stores the result in the device specified by (d). | Page 710 DWSUM(P)(_U) |
| DWSUM_U            |                                                                                                                                                       |                       |
| DWSUMP             |                                                                                                                                                       |                       |
| DWSUMP_U           |                                                                                                                                                       |                       |

## ■Calculating the mean value of 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                                                                                               | Reference            |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| MEAN               | Calculates the average value of the (n) points of 16-bit data in the device starting from the one specified by (s), and stores the average value in the device specified by (d). | Page 712 MEAN(P)(_U) |
| MEANP              |                                                                                                                                                                                  |                      |
| MEAN_U             |                                                                                                                                                                                  |                      |
| MEANP_U            |                                                                                                                                                                                  |                      |



| Instruction symbol | Processing details                                                                                                                                                               | Reference             |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| DMEAN              | Calculates the average value of the (n) points of 32-bit data in the device starting from the one specified by (s), and stores the average value in the device specified by (d). | Page 714 DMEAN(P)(_U) |
| DMEANP             |                                                                                                                                                                                  |                       |
| DMEAN_U            |                                                                                                                                                                                  |                       |
| DMEANP_U           |                                                                                                                                                                                  |                       |

### ■Calculating the square root of 16-bit/32-bit binary data

| Instruction symbol | Processing details                                                                                           | Reference         |
|--------------------|--------------------------------------------------------------------------------------------------------------|-------------------|
| SQRT               | Performs a square root operation of the specified 16-bit binary data.<br>$\sqrt{(s)} \rightarrow (d)$        | Page 716 SQRT(P)  |
| SQRTP              |                                                                                                              |                   |
| DSQRT              | Performs a square root operation of the specified 32-bit binary data.<br>$\sqrt{(s)+1}, (s) \rightarrow (d)$ | Page 717 DSQRT(P) |
| DSQRTP             |                                                                                                              |                   |

### ■CRC operation

| Instruction symbol | Processing details                                                                                                                                         | Reference       |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CRC                | Generates the CRC value for (n) 8-bit data (unit: byte) starting from the device specified by (s), and store the CRC value to the device specified by (d). | Page 718 CRC(P) |
| CRCP               |                                                                                                                                                            |                 |

# Debugging and failure diagnostic

## Debugging and failure diagnostic instructions

### ■Resetting the error display and the annunciator display

| Instruction symbol | Processing details                                                                                                            | Reference      |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------|----------------|
| LED R              | This instruction resets the self-diagnostic error (continuation error) display and the annunciator display of the controller. | Page 720 LED R |

## String processing

### String processing instructions

#### ■Comparing string data

| Instruction symbol      | Processing details                                                                                | Reference                     |
|-------------------------|---------------------------------------------------------------------------------------------------|-------------------------------|
| LD\$=, AND\$=, OR\$=    | Compares the string specified by (s1) with the string specified by (s2) (character by character). | Page 722 LD\$□, AND\$□, OR\$□ |
| LD\$<>, AND\$<>, OR\$<> |                                                                                                   |                               |
| LD\$>, AND\$>, OR\$>    |                                                                                                   |                               |
| LD\$<=, AND\$<=, OR\$<= |                                                                                                   |                               |
| LD\$<, AND\$<, OR\$<    |                                                                                                   |                               |
| LD\$>=, AND\$>=, OR\$>= |                                                                                                   |                               |

#### ■Concatenating string data

| Instruction symbol | Processing details                                                                                                                                                     | Reference                                     |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| \$+                | Connects the strings in the device specified by (s) to those in the device specified by (d), and stores the connected data in the device specified by (d) and later.   | Page 725 \$+(P) [when two operands are set]   |
| \$+P               |                                                                                                                                                                        |                                               |
| \$+                | Connects the strings in the device specified by (s2) to those in the device specified by (s1), and stores the connected data in the device specified by (d) and later. | Page 727 \$+(P) [when three operands are set] |
| \$+P               |                                                                                                                                                                        |                                               |

#### ■Transferring string data

| Instruction symbol | Processing details                                                                                     | Reference            |
|--------------------|--------------------------------------------------------------------------------------------------------|----------------------|
| \$MOV              | Transfers the strings in the device specified by (s) to the device specified by (d) and later.         | Page 729 \$MOV(P)    |
| \$MOVP             |                                                                                                        |                      |
| \$MOV_WS           | Transfers the Unicode strings in the device specified by (s) to the device specified by (d) and later. | Page 731 \$MOV(P)_WS |
| \$MOVP_WS          |                                                                                                        |                      |

#### ■Converting 16-bit/32-bit binary data to decimal ASCII

| Instruction symbol | Processing details                                                                                                                                                        | Reference              |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| BINDA              | Converts the 1-word binary data in the device specified by (s) to decimal ASCII data, and stores the converted data in the word device number specified by (d) and later. | Page 733 BINDA(P)(_U)  |
| BINDAP             |                                                                                                                                                                           |                        |
| BINDA_U            |                                                                                                                                                                           |                        |
| BINDAP_U           |                                                                                                                                                                           |                        |
| DBINDA             | Converts the 2-word binary data in the device specified by (s) to decimal ASCII data, and stores the converted data in the word device number specified by (d) and later. | Page 737 DBINDA(P)(_U) |
| DBINDAP            |                                                                                                                                                                           |                        |
| DBINDA_U           |                                                                                                                                                                           |                        |
| DBINDAP_U          |                                                                                                                                                                           |                        |

## ■Converting 16-bit/32-bit binary data to hexadecimal ASCII

| Instruction symbol | Processing details                                                                                                                                                            | Reference          |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| BINHA              | Converts the 1-word binary data in the device specified by (s) to hexadecimal ASCII data, and stores the converted data in the word device number specified by (d) and later. | Page 742 BINHA(P)  |
| BINHAP             |                                                                                                                                                                               |                    |
| DBINHA             | Converts the 2-word binary data in the device specified by (s) to hexadecimal ASCII data, and stores the converted data in the word device number specified by (d) and later. | Page 746 DBINHA(P) |
| DBINHAP            |                                                                                                                                                                               |                    |

## ■Converting 16-bit/32-bit binary data to string data

| Instruction symbol | Processing details                                                                                                                                                                                                                                                       | Reference           |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| STR                | Converts the 1-word binary data in the device specified by (s2) to a decimal string consisting of the total number of digits and the number of digits in the decimal part in the device specified by (s1), and stores the converted data in the device specified by (d). | Page 750 STR(P)(U)  |
| STRP               |                                                                                                                                                                                                                                                                          |                     |
| STR_U              |                                                                                                                                                                                                                                                                          |                     |
| STRP_U             |                                                                                                                                                                                                                                                                          |                     |
| DSTR               | Converts the 2-word binary data in the device specified by (s2) to a decimal string consisting of the total number of digits and the number of digits in the decimal part in the device specified by (s1), and stores the converted data in the device specified by (d). | Page 753 DSTR(P)(U) |
| DSTRP              |                                                                                                                                                                                                                                                                          |                     |
| DSTR_U             |                                                                                                                                                                                                                                                                          |                     |
| DSTRP_U            |                                                                                                                                                                                                                                                                          |                     |

## ■Converting BCD 4-digit/8-digit data to decimal ASCII code

| Instruction symbol | Processing details                                                                                                                                                     | Reference          |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| BCDDA              | Converts the 1-word BCD data in the device specified by (s) to decimal ASCII data, and stores the converted data in the word device number specified by (d) and later. | Page 756 BCDDA(P)  |
| BCDDAP             |                                                                                                                                                                        |                    |
| DBCDDA             | Converts the 2-word BCD data in the device specified by (s) to decimal ASCII data, and stores the converted data in the word device number specified by (d) and later. | Page 760 DBCDDA(P) |
| DBCDDAP            |                                                                                                                                                                        |                    |

## ■Converting single-precision real number to string data

| Instruction symbol | Processing details                                                                                                                                   | Reference        |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| ESTR               | Converts the single-precision real number in the device specified by (s1) to a string, and stores the converted data in the device specified by (d). | Page 765 ESTR(P) |
| ESTRP              |                                                                                                                                                      |                  |

## ■Converting hexadecimal binary data to hexadecimal ASCII code

| Instruction symbol | Processing details                                                                                                                                                                                                                                   | Reference           |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| INT2ASC            | Converts the 1-word binary data in the device number specified by (s) and later to hexadecimal ASCII, and stores the converted data by the number of characters in the device specified by (n) in the word device number specified by (d) and later. | Page 770 INT2ASC(P) |
| INT2ASCP           |                                                                                                                                                                                                                                                      |                     |

## ■Converting and concatenating multiple data strings

| Instruction symbol | Processing details                                                                                                                                          | Reference       |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| SPF                | Converts multiple data to a string according to the specified display format, concatenates the string with any string, and outputs them as a single string. | Page 772 SPF(P) |
| SPFP               |                                                                                                                                                             |                 |

## ■Converting Unicode string to Shift JIS string

| Instruction symbol | Processing details                                                                                                                                | Reference           |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| WS2SJIS            | Converts the Unicode string in the device specified by (s) to the shift JIS string, and stores the converted data in the device specified by (d). | Page 789 WS2SJIS(P) |
| WS2SJISP           |                                                                                                                                                   |                     |

## ■Converting shift JIS string to Unicode string (without byte order mark)

| Instruction symbol | Processing details                                                                                                                              | Reference           |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| SJIS2WS            | Converts the shift JIS string in the device specified by (s) to a Unicode string, and stores the converted data in the device specified by (d). | Page 791 SJIS2WS(P) |
| SJIS2WSP           |                                                                                                                                                 |                     |

## ■Converting shift JIS to Unicode (with byte order mark)

| Instruction symbol | Processing details                                                                                                                                                                         | Reference            |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| SJIS2WSB           | Converts the shift JIS string in the device specified by (s) to the Unicode string, add a byte order mark to the head of the converted data, and stores it in the device specified by (d). | Page 793 SJIS2WSB(P) |
| SJIS2WSBP          |                                                                                                                                                                                            |                      |

## ■Detecting a string length

| Instruction symbol | Processing details                                                                                                                               | Reference       |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| LEN                | Stores the length (the number of characters) of the string data, which is stored in the device specified by (s), in the device specified by (d). | Page 795 LEN(P) |
| LENP               |                                                                                                                                                  |                 |

## ■Extracting string data from the right/left

| Instruction symbol | Processing details                                                                                                                                | Reference         |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| RIGHT              | Stores the (n) characters from the last character of the string, which is stored in the device specified by (s), in the device specified by (d).  | Page 797 RIGHT(P) |
| RIGHTP             |                                                                                                                                                   |                   |
| LEFT               | Stores the (n) characters from the first character of the string, which is stored in the device specified by (s), in the device specified by (d). | Page 799 LEFT(P)  |
| LEFTP              |                                                                                                                                                   |                   |

## ■Extracting/replacing the specified string data

| Instruction symbol | Processing details                                                                                                                                                                                                 | Reference        |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| MIDR               | Retrieves the string in the device specified by (s1) by the number of specified characters from the location in the device specified by (s2), and stores the retrieved data in the device specified by (d).        | Page 801 MIDR(P) |
| MIDRP              |                                                                                                                                                                                                                    |                  |
| MIDW               | Retrieves the specified number of characters from the string in the device specified by (s1), and stores the retrieved data at the location specified by (s2) in the string stored in the device specified by (d). | Page 803 MIDW(P) |
| MIDWP              |                                                                                                                                                                                                                    |                  |

## ■Searching string data

| Instruction symbol | Processing details                                                                                                                                                                                        | Reference         |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| INSTR              | Searches the string in the device specified by (s2), starting from the (s3)th character, for the string in the device specified by (s1), and stores the matching location in the device specified by (d). | Page 806 INSTR(P) |
| INSTRP             |                                                                                                                                                                                                           |                   |

## ■Inserting string data

| Instruction symbol | Processing details                                                                                                                                                    | Reference          |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| STRINS             | Inserts the string data in the device specified by (s1) to the (s2)th character (insertion position) from the head of the string data in the device specified by (d). | Page 808 STRINS(P) |
| STRINSP            |                                                                                                                                                                       |                    |

## ■Deleting string data

| Instruction symbol | Processing details                                                                                                                                                                | Reference          |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| STRDEL             | Deletes the (n) characters starting from the position (deletion start position) specified by the (s)th character from the head of the string data in the device specified by (d). | Page 810 STRDEL(P) |
| STRDELP            |                                                                                                                                                                                   |                    |

# Real value processing

## Floating-point instruction

### ■Comparing single-precision real numbers

| Instruction symbol   | Processing details                                                                                                | Reference                  |
|----------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------|
| LDE=, ANDE=, ORE=    | Performs a comparison operation of a single-precision real number. (Devices are used as a normally open contact.) | Page 812 LDE□, ANDE□, ORE□ |
| LDE<>, ANDE<>, ORE<> |                                                                                                                   |                            |
| LDE>, ANDE>, ORE>    |                                                                                                                   |                            |
| LDE<=, ANDE<=, ORE<= |                                                                                                                   |                            |
| LDE<, ANDE<, ORE<    |                                                                                                                   |                            |
| LDE>=, ANDE>=, ORE>= |                                                                                                                   |                            |

### ■Comparing double-precision real numbers

| Instruction symbol      | Processing details                                                                                                | Reference                     |
|-------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------|
| LDED=, ANDED=, ORED=    | Performs a comparison operation of a double-precision real number. (Devices are used as a normally open contact.) | Page 814 LDED□, ANDED□, ORED□ |
| LDED<>, ANDED<>, ORED<> |                                                                                                                   |                               |
| LDED>, ANDED>, ORED>    |                                                                                                                   |                               |
| LDED<=, ANDED<=, ORED<= |                                                                                                                   |                               |
| LDED<, ANDED<, ORED<    |                                                                                                                   |                               |
| LDED>=, ANDED>=, ORED>= |                                                                                                                   |                               |

### ■Adding/subtracting single-precision real numbers

| Instruction symbol | Processing details                                                                 | Reference                                    |
|--------------------|------------------------------------------------------------------------------------|----------------------------------------------|
| E+                 | Adds single-precision real numbers. (Using two operands)                           | Page 817 E+(P) [when two operands are set]   |
| E+P                |                                                                                    |                                              |
| E+                 | Adds single-precision real numbers. (Using three operands)                         | Page 819 E+(P) [when three operands are set] |
| E+P                |                                                                                    |                                              |
| E-                 | Performs subtraction between single-precision real numbers. (Using two operands)   | Page 821 E-(P) [when two operands are set]   |
| E-P                |                                                                                    |                                              |
| E-                 | Performs subtraction between single-precision real numbers. (Using three operands) | Page 823 E-(P) [when three operands are set] |
| E-P                |                                                                                    |                                              |

### ■Adding/subtracting double-precision real numbers

| Instruction symbol | Processing details                                                                 | Reference                                     |
|--------------------|------------------------------------------------------------------------------------|-----------------------------------------------|
| ED+                | Adds double-precision real numbers. (Using two operands)                           | Page 825 ED+(P) [when two operands are set]   |
| ED+P               |                                                                                    |                                               |
| ED+                | Adds double-precision real numbers. (Using three operands)                         | Page 827 ED+(P) [when three operands are set] |
| ED+P               |                                                                                    |                                               |
| ED-                | Performs subtraction between double-precision real numbers. (Using two operands)   | Page 829 ED-(P) [when two operands are set]   |
| ED-P               |                                                                                    |                                               |
| ED-                | Performs subtraction between double-precision real numbers. (Using three operands) | Page 831 ED-(P) [when three operands are set] |
| ED-P               |                                                                                    |                                               |

## ■ Multiplying/dividing single-precision real numbers

| Instruction symbol | Processing details                                       | Reference      |
|--------------------|----------------------------------------------------------|----------------|
| E*                 | Multiplies single-precision real numbers.                | Page 833 E*(P) |
| E*P                |                                                          |                |
| E/                 | Performs division between single-precision real numbers. | Page 835 E/(P) |
| E/P                |                                                          |                |

## ■ Multiplying/dividing double-precision real numbers

| Instruction symbol | Processing details                                       | Reference       |
|--------------------|----------------------------------------------------------|-----------------|
| ED*                | Multiplies double-precision real numbers.                | Page 837 ED*(P) |
| ED*P               |                                                          |                 |
| ED/                | Performs division between double-precision real numbers. | Page 839 ED/(P) |
| ED/P               |                                                          |                 |

## ■ Converting 16-bit/32-bit signed binary data to single-precision real number

| Instruction symbol | Processing details                                                                                                                                                     | Reference            |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| INT2FLT            | Converts the 16-bit signed binary data in the device specified by (s) to a single-precision real number, and stores the converted data in the device specified by (d). | Page 841 INT2FLT(P)  |
| INT2FLTP           |                                                                                                                                                                        |                      |
| DINT2FLT           | Converts the 32-bit signed binary data in the device specified by (s) to a single-precision real number, and stores the real number in the device specified by (d).    | Page 843 DINT2FLT(P) |
| DINT2FLTP          |                                                                                                                                                                        |                      |

## ■ Converting 16-bit/32-bit unsigned binary data to single-precision real number

| Instruction symbol | Processing details                                                                                                                                                    | Reference             |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| UINT2FLT           | Converts the 16-bit unsigned binary data in the device specified by (s) to a single-precision real number, and stores the real number in the device specified by (d). | Page 842 UINT2FLT(P)  |
| UINT2FLTP          |                                                                                                                                                                       |                       |
| UDINT2FLT          | Converts the 32-bit unsigned binary data in the device specified by (s) to a single-precision real number, and stores the real number in the device specified by (d). | Page 845 UDINT2FLT(P) |
| UDINT2FLTP         |                                                                                                                                                                       |                       |

## ■ Converting double-precision real number to single-precision real number

| Instruction symbol | Processing details                                                                                                                                                     | Reference           |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| DBL2FLT            | Converts the double-precision real number in the device specified by (s) to a single-precision real number, and stores the real number in the device specified by (d). | Page 847 DBL2FLT(P) |
| DBL2FLTP           |                                                                                                                                                                        |                     |

## ■ Converting 16-bit/32-bit signed binary data to double-precision real number

| Instruction symbol | Processing details                                                                                                                                                  | Reference            |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| INT2DBL            | Converts the 16-bit signed binary data in the device specified by (s) to a double-precision real number, and stores the real number in the device specified by (d). | Page 849 INT2DBL(P)  |
| INT2DBLP           |                                                                                                                                                                     |                      |
| DINT2DBL           | Converts the 32-bit signed binary data in the device specified by (s) to a double-precision real number, and stores the real number in the device specified by (d). | Page 851 DINT2DBL(P) |
| DINT2DBLP          |                                                                                                                                                                     |                      |

## ■ Converting 16-bit/32-bit unsigned binary data to double-precision real number

| Instruction symbol | Processing details                                                                                                                                                    | Reference             |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| UINT2DBL           | Converts the 16-bit unsigned binary data in the device specified by (s) to a double-precision real number, and stores the real number in the device specified by (d). | Page 850 UINT2DBL(P)  |
| UINT2DBLP          |                                                                                                                                                                       |                       |
| UDINT2DBL          | Converts the 32-bit unsigned binary data in the device specified by (s) to a double-precision real number, and stores the real number in the device specified by (d). | Page 852 UDINT2DBL(P) |
| UDINT2DBLP         |                                                                                                                                                                       |                       |

## ■Converting single-precision real number to double-precision real number

| Instruction symbol | Processing details                                                                                                                                                                      | Reference           |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| FLT2DBL            | Converts the single-precision real number in the device specified by (s) to a double-precision real number, and stores the double-precision real number in the device specified by (d). | Page 853 FLT2DBL(P) |
| FLT2DBLP           |                                                                                                                                                                                         |                     |

## ■Converting string data to single-precision real number

| Instruction symbol | Processing details                                                                                                                                  | Reference        |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| EVAL               | Converts the string in the device specified by (s) to a single-precision real number, and stores the converted data in the device specified by (d). | Page 855 EVAL(P) |
| EVALP              |                                                                                                                                                     |                  |

## ■Converting BCD format data to single-precision real number

| Instruction symbol | Processing details                                                                                                                                                                                            | Reference         |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| EREXP              | Converts the BCD data in the device specified by (s1) to a single-precision real number with the number of decimal positions specified by (s2), and stores the converted data in the device specified by (d). | Page 860 EREXP(P) |
| EREXPP             |                                                                                                                                                                                                               |                   |

## ■Inverting the sign of single-precision real number

| Instruction symbol | Processing details                                                                                                        | Reference        |
|--------------------|---------------------------------------------------------------------------------------------------------------------------|------------------|
| ENEG               | Inverts the sign of single-precision real number data.                                                                    | Page 862 ENEG(P) |
| ENEGP              | $\begin{array}{c} \overline{(d)+1, (d)} \longrightarrow (d)+1, (d) \\ \uparrow \\ (1) \end{array}$ <p>(1) Real number</p> |                  |

## ■Inverting the sign of double-precision real number

| Instruction symbol | Processing details                                                                                                                                    | Reference         |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| EDNEG              | Inverts the sign of double-precision real number data.                                                                                                | Page 863 EDNEG(P) |
| EDNEGP             | $\begin{array}{c} \overline{(d)+3, (d)+2, (d)+1, (d)} \longrightarrow (d)+3, (d)+2, (d)+1, (d) \\ \uparrow \\ (1) \end{array}$ <p>(1) Real number</p> |                   |

## ■Transferring single-precision real number

| Instruction symbol | Processing details                                                                                                        | Reference        |
|--------------------|---------------------------------------------------------------------------------------------------------------------------|------------------|
| EMOV               | Transfers single-precision real number data to the specified device.                                                      | Page 864 EMOV(P) |
| EMOVP              | $\begin{array}{c} \overline{(s)+1, (s)} \longrightarrow (d)+1, (d) \\ \uparrow \\ (1) \end{array}$ <p>(1) Real number</p> |                  |

## ■Transferring double-precision real number

| Instruction symbol | Processing details                                                                                                                                    | Reference         |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| EDMOV              | Transfers double-precision real number data to the specified device.                                                                                  | Page 865 EDMOV(P) |
| EDMOVP             | $\begin{array}{c} \overline{(s)+3, (s)+2, (s)+1, (s)} \longrightarrow (d)+3, (d)+2, (d)+1, (d) \\ \uparrow \\ (1) \end{array}$ <p>(1) Real number</p> |                   |

## ■Calculating the sine of single-precision real number

| Instruction symbol | Processing details                                                            | Reference       |
|--------------------|-------------------------------------------------------------------------------|-----------------|
| SIN                | Calculates the sine of the angle specified by a single-precision real number. | Page 866 SIN(P) |
| SINP               |                                                                               |                 |

### ■Calculating the cosine of single-precision real number

| Instruction symbol | Processing details                                                              | Reference       |
|--------------------|---------------------------------------------------------------------------------|-----------------|
| COS                | Calculates the cosine of the angle specified by a single-precision real number. | Page 868 COS(P) |
| COSP               |                                                                                 |                 |

### ■Calculating the tangent of single-precision real number

| Instruction symbol | Processing details                                                               | Reference       |
|--------------------|----------------------------------------------------------------------------------|-----------------|
| TAN                | Calculates the tangent of the angle specified by a single-precision real number. | Page 870 TAN(P) |
| TANP               |                                                                                  |                 |

### ■Calculating the arc sine of single-precision real number

| Instruction symbol | Processing details                                                              | Reference        |
|--------------------|---------------------------------------------------------------------------------|------------------|
| ASIN               | Calculates the angle from the sine specified by a single-precision real number. | Page 872 ASIN(P) |
| ASINP              |                                                                                 |                  |

### ■Calculating the arc cosine of single-precision real number

| Instruction symbol | Processing details                                                                | Reference        |
|--------------------|-----------------------------------------------------------------------------------|------------------|
| ACOS               | Calculates the angle from the cosine specified by a single-precision real number. | Page 874 ACOS(P) |
| ACOSP              |                                                                                   |                  |

### ■Calculating the arc tangent of single-precision real number

| Instruction symbol | Processing details                                                                 | Reference        |
|--------------------|------------------------------------------------------------------------------------|------------------|
| ATAN               | Calculates the angle from the tangent specified by a single-precision real number. | Page 876 ATAN(P) |
| ATANP              |                                                                                    |                  |

### ■Calculating the sine of double-precision real number

| Instruction symbol | Processing details                                                            | Reference        |
|--------------------|-------------------------------------------------------------------------------|------------------|
| SIND               | Calculates the sine of the angle specified by a double-precision real number. | Page 878 SIND(P) |
| SINDP              |                                                                               |                  |

### ■Calculating the cosine of double-precision real number

| Instruction symbol | Processing details                                                              | Reference        |
|--------------------|---------------------------------------------------------------------------------|------------------|
| COSD               | Calculates the cosine of the angle specified by a double-precision real number. | Page 880 COSD(P) |
| COSDP              |                                                                                 |                  |

### ■Calculating the tangent of double-precision real number

| Instruction symbol | Processing details                                                               | Reference        |
|--------------------|----------------------------------------------------------------------------------|------------------|
| TAND               | Calculates the tangent of the angle specified by a double-precision real number. | Page 882 TAND(P) |
| TANDP              |                                                                                  |                  |

### ■Calculating the arc sine of double-precision real number

| Instruction symbol | Processing details                                                              | Reference         |
|--------------------|---------------------------------------------------------------------------------|-------------------|
| ASIND              | Calculates the angle from the sine specified by a double-precision real number. | Page 884 ASIND(P) |
| ASINDP             |                                                                                 |                   |



### ■Calculating the arc cosine of double-precision real number

| Instruction symbol | Processing details                                                                | Reference         |
|--------------------|-----------------------------------------------------------------------------------|-------------------|
| ACOSD              | Calculates the angle from the cosine specified by a double-precision real number. | Page 886 ACOSD(P) |
| ACOSDP             |                                                                                   |                   |

### ■Calculating the arc tangent of double-precision real number

| Instruction symbol | Processing details                                                                 | Reference         |
|--------------------|------------------------------------------------------------------------------------|-------------------|
| ATAND              | Calculates the angle from the tangent specified by a double-precision real number. | Page 888 ATAND(P) |
| ATANDP             |                                                                                    |                   |

### ■Calculating the sine of BCD data

| Instruction symbol | Processing details                                         | Reference        |
|--------------------|------------------------------------------------------------|------------------|
| BSIN               | Calculates the sine of the angle specified by a BCD value. | Page 890 BSIN(P) |
| BSINP              |                                                            |                  |

$\text{SIN}(s) \longrightarrow \begin{array}{|c|} \hline (d) \\ \hline (d)+1 \\ \hline (d)+2 \\ \hline \end{array}$

(d): Sign  
 (d)+1: Integral part  
 (d)+2: Decimal part

### ■Calculating the cosine of BCD data

| Instruction symbol | Processing details                                           | Reference        |
|--------------------|--------------------------------------------------------------|------------------|
| BCOS               | Calculates the cosine of the angle specified by a BCD value. | Page 892 BCOS(P) |
| BCOSP              |                                                              |                  |

$\text{COS}(s) \longrightarrow \begin{array}{|c|} \hline (d) \\ \hline (d)+1 \\ \hline (d)+2 \\ \hline \end{array}$

(d): Sign  
 (d)+1: Integral part  
 (d)+2: Decimal part

### ■Calculating the tangent of BCD data

| Instruction symbol | Processing details                                            | Reference        |
|--------------------|---------------------------------------------------------------|------------------|
| BTAN               | Calculates the tangent of the angle specified by a BCD value. | Page 894 BTAN(P) |
| BTANP              |                                                               |                  |

$\text{TAN}(s) \longrightarrow \begin{array}{|c|} \hline (d) \\ \hline (d)+1 \\ \hline (d)+2 \\ \hline \end{array}$

(d): Sign  
 (d)+1: Integral part  
 (d)+2: Decimal part

### ■Calculating the arc sine of BCD data

| Instruction symbol | Processing details                                             | Reference         |
|--------------------|----------------------------------------------------------------|-------------------|
| BASIN              | Calculates the arc sine of the angle specified by a BCD value. | Page 896 BASIN(P) |
| BASINP             |                                                                |                   |

$\text{SIN}^{-1}(s) \longrightarrow \begin{array}{|c|} \hline (d) \\ \hline (d)+1 \\ \hline (d)+2 \\ \hline \end{array}$

(d): Sign  
 (d)+1: Integral part  
 (d)+2: Decimal part

## ■Calculating the arc cosine of BCD data

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                       | Reference         |     |       |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----|-------|
| BACOS              | Calculates the arc cosine of the angle specified by a BCD value.                                                                                                                                                                                                                         | Page 898 BACOS(P) |     |       |
| BACOSP             | <div>COS<sup>-1</sup> (s)    </div> <table border="1"><tr><td>(d)</td></tr><tr><td>(d)+1</td></tr><tr><td>(d)+2</td></tr></table> <div>(d): Sign<br/>(d)+1: Integral part<br/>(d)+2: Decimal part</div> |                   | (d) | (d)+1 |
| (d)                |                                                                                                                                                                                                                                                                                          |                   |     |       |
| (d)+1              |                                                                                                                                                                                                                                                                                          |                   |     |       |
| (d)+2              |                                                                                                                                                                                                                                                                                          |                   |     |       |

## ■Calculating the arc tangent of BCD data

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                       | Reference         |     |       |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----|-------|
| BATAN              | Calculates the arc tangent of the angle specified by a BCD value.                                                                                                                                                                                                                        | Page 900 BATAN(P) |     |       |
| BATANP             | <div>TAN<sup>-1</sup> (s)    </div> <table border="1"><tr><td>(d)</td></tr><tr><td>(d)+1</td></tr><tr><td>(d)+2</td></tr></table> <div>(d): Sign<br/>(d)+1: Integral part<br/>(d)+2: Decimal part</div> |                   | (d) | (d)+1 |
| (d)                |                                                                                                                                                                                                                                                                                          |                   |     |       |
| (d)+1              |                                                                                                                                                                                                                                                                                          |                   |     |       |
| (d)+2              |                                                                                                                                                                                                                                                                                          |                   |     |       |

## ■Converting single-precision real number angle to radian

| Instruction symbol | Processing details                                                                                               | Reference       |
|--------------------|------------------------------------------------------------------------------------------------------------------|-----------------|
| RAD                | Converts the unit of the measure of angle from the degree specified by a single-precision real number to radian. | Page 902 RAD(P) |
| RADP               | Converting degree to radian<br>$(s)+1, (s) \longrightarrow (d)+1, (d)$                                           |                 |

## ■Converting single-precision real number radian to angle

| Instruction symbol | Processing details                                                                                                   | Reference       |
|--------------------|----------------------------------------------------------------------------------------------------------------------|-----------------|
| DEG                | Converts the unit of the measure of angle from the radian specified by a single-precision real number to the degree. | Page 904 DEG(P) |
| DEGP               | Converting radian to degree<br>$(s)+1, (s) \longrightarrow (d)+1, (d)$                                               |                 |

## ■Converting double-precision real number angle to radian

| Instruction symbol | Processing details                                                                                               | Reference        |
|--------------------|------------------------------------------------------------------------------------------------------------------|------------------|
| RADD               | Converts the unit of the measure of angle from the degree specified by a single-precision real number to radian. | Page 906 RADD(P) |
| RADDP              | Converting degree to radian<br>$(s)+3, (s)+2, (s)+1, (s) \longrightarrow (d)+3, (d)+2, (d)+1, (d)$               |                  |

## ■Converting double-precision real number radian to angle

| Instruction symbol | Processing details                                                                                                   | Reference        |
|--------------------|----------------------------------------------------------------------------------------------------------------------|------------------|
| DEGD               | Converts the unit of the measure of angle from the radian specified by a double-precision real number to the degree. | Page 908 DEGD(P) |
| DEGDP              | Converting radian to degree<br>$(s)+3, (s)+2, (s)+1, (s) \longrightarrow (d)+3, (d)+2, (d)+1, (d)$                   |                  |

### ■Calculating the square root of single-precision real number

| Instruction symbol | Processing details                                                                   | Reference         |
|--------------------|--------------------------------------------------------------------------------------|-------------------|
| ESQRT              | Calculates the square root of the value specified by a single-precision real number. | Page 910 ESQRT(P) |
| ESQRTP             | $\sqrt{(s)+1, (s)} \longrightarrow (d)+1, (d)$                                       |                   |

### ■Calculating the square root of double-precision real number

| Instruction symbol | Processing details                                                                   | Reference          |
|--------------------|--------------------------------------------------------------------------------------|--------------------|
| EDSQRT             | Calculates the square root of the value specified by a double-precision real number. | Page 912 EDSQRT(P) |
| EDSQRTP            | $\sqrt{(s)+3, (s)+2, (s)+1, (s)} \longrightarrow (d)+3, (d)+2, (d)+1, (d)$           |                    |

### ■Calculating the exponent of single-precision real number

| Instruction symbol | Processing details                                                                | Reference       |
|--------------------|-----------------------------------------------------------------------------------|-----------------|
| EXP                | Calculates the exponent of the value specified by a single-precision real number. | Page 914 EXP(P) |
| EXPP               |                                                                                   |                 |

### ■Calculating the exponent of double-precision real number

| Instruction symbol | Processing details                                                                | Reference        |
|--------------------|-----------------------------------------------------------------------------------|------------------|
| EXPD               | Calculates the exponent of the value specified by a double-precision real number. | Page 916 EXPD(P) |
| EXPDP              |                                                                                   |                  |

### ■Calculating the natural logarithm of single-precision real number

| Instruction symbol | Processing details                                                                                                             | Reference       |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------|
| LOG                | Calculates the logarithm using the natural logarithm (e) of the value specified by a single-precision real number as the base. | Page 918 LOG(P) |
| LOGP               |                                                                                                                                |                 |

### ■Calculating the natural logarithm of double-precision real number

| Instruction symbol | Processing details                                                                                                             | Reference        |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------|------------------|
| LOGD               | Calculates the logarithm using the natural logarithm (e) of the value specified by a double-precision real number as the base. | Page 920 LOGD(P) |
| LOGDP              |                                                                                                                                |                  |

### ■Calculating the square root of BCD 4-digit/8-digit data

| Instruction symbol | Processing details                                                                                                                                   | Reference          |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| BSQRT              | Calculates the square root of the value specified by a BCD 4-digit data.                                                                             | Page 922 BSQRT(P)  |
| BSQRTP             | $\sqrt{(s)} \longrightarrow \begin{array}{ c } \hline (d) \\ \hline (d)+1 \\ \hline \end{array}$<br>(d): Integral part<br>(d)+1: Decimal part        |                    |
| BDSQRT             | Calculates the square root of the value specified by a BCD 8-digit data.                                                                             | Page 924 BDSQRT(P) |
| BDSQRTP            | $\sqrt{(s)+1, (s)} \longrightarrow \begin{array}{ c } \hline (d) \\ \hline (d)+1 \\ \hline \end{array}$<br>(d): Integral part<br>(d)+1: Decimal part |                    |

### ■Calculating the exponentiation of single-precision real number

| Instruction symbol | Processing details                                               | Reference       |
|--------------------|------------------------------------------------------------------|-----------------|
| POW                | Calculates the exponentiation of a single-precision real number. | Page 926 POW(P) |
| POWP               |                                                                  |                 |

## ■Calculating the exponentiation of double-precision real number

| Instruction symbol | Processing details                                               | Reference        |
|--------------------|------------------------------------------------------------------|------------------|
| POWD               | Calculates the exponentiation of a double-precision real number. | Page 928 POWD(P) |
| POWDP              |                                                                  |                  |

## ■Calculating the common logarithm of single-precision real number

| Instruction symbol | Processing details                                                                                                                   | Reference         |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| LOG10              | Calculates the logarithm using the common logarithm (using 10 as the base) of the value specified by a single-precision real number. | Page 930 LOG10(P) |
| LOG10P             |                                                                                                                                      |                   |

## ■Calculating the common logarithm of double-precision real number

| Instruction symbol | Processing details                                                                                                                   | Reference          |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| LOG10D             | Calculates the logarithm using the common logarithm (using 10 as the base) of the value specified by a double-precision real number. | Page 932 LOG10D(P) |
| LOG10DP            |                                                                                                                                      |                    |

## ■Searching the maximum value of single-precision real number

| Instruction symbol | Processing details                                                                                                                                                                                                                                  | Reference        |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| EMAX               | Searches for the maximum value in the (n) points of single-precision real number block data in the device starting from the one specified by (s), and stores the maximum value in the search result (maximum value) in the device specified by (d). | Page 934 EMAX(P) |
| EMAXP              |                                                                                                                                                                                                                                                     |                  |

## ■Searching the maximum value of double-precision real number

| Instruction symbol | Processing details                                                                                                                                                                                                                                  | Reference         |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| EDMAX              | Searches for the maximum value in the (n) points of double-precision real number block data in the device starting from the one specified by (s), and stores the maximum value in the search result (maximum value) in the device specified by (d). | Page 936 EDMAX(P) |
| EDMAXP             |                                                                                                                                                                                                                                                     |                   |

## ■Searching the minimum value of single-precision real number

| Instruction symbol | Processing details                                                                                                                                                                                                                                  | Reference        |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| EMIN               | Searches for the minimum value in the (n) points of single-precision real number block data in the device starting from the one specified by (s), and stores the maximum value in the search result (minimum value) in the device specified by (d). | Page 938 EMIN(P) |
| EMINP              |                                                                                                                                                                                                                                                     |                  |

## ■Searching the minimum value of double-precision real number

| Instruction symbol | Processing details                                                                                                                                                                                                                                  | Reference         |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| EDMIN              | Searches for the minimum value in the (n) points of double-precision real number block data in the device starting from the one specified by (s), and stores the maximum value in the search result (minimum value) in the device specified by (d). | Page 940 EDMIN(P) |
| EDMINP             |                                                                                                                                                                                                                                                     |                   |

# Random number

## Random number instructions

### ■Generating random number, changing random sequence

| Instruction symbol | Processing details                                                                                                           | Reference        |
|--------------------|------------------------------------------------------------------------------------------------------------------------------|------------------|
| RND<br>RNDP        | Generates a random number between 0 and less than 32767, and stores the random number in the device specified by (d).        | Page 942 RND(P)  |
| SRND<br>SRNDP      | Changes the random number sequence according to the content of the 16-bit binary data stored in the device specified by (s). | Page 943 SRND(P) |

# Device operation

## Index register instructions

### ■Saving/returning all data of the index register

| Instruction symbol | Processing details                                                                                    | Reference         |
|--------------------|-------------------------------------------------------------------------------------------------------|-------------------|
| ZPUSH              | Saves data of the index register to the area specified by (d).                                        | Page 944 ZPUSH(P) |
| ZPUSHP             |                                                                                                       |                   |
| ZPOP               | Reads the data, which has been saved to the area specified by (d) and later, into the index register. | Page 947 ZPOP(P)  |
| ZPOPP              |                                                                                                       |                   |

### ■Saving/returning the selected data of the index register and long index register

| Instruction symbol | Processing details                                                                                                  | Reference         |
|--------------------|---------------------------------------------------------------------------------------------------------------------|-------------------|
| ZPUSH              | Saves the contents of the index register and long index register specified by (s) to the area specified by (d).     | Page 948 ZPUSH(P) |
| ZPUSHP             |                                                                                                                     |                   |
| ZPOP               | Reads the data, which has been saved to the area specified by (d), into the index register and long index register. | Page 952 ZPOP(P)  |
| ZPOPP              |                                                                                                                     |                   |

## File register operation instructions

### ■Switching the file register block number

| Instruction symbol | Processing details                                                                                                | Reference        |
|--------------------|-------------------------------------------------------------------------------------------------------------------|------------------|
| RSET               | Switches the block number of the file register used in the program to that stored in the device specified by (s). | Page 954 RSET(P) |
| RSETP              |                                                                                                                   |                  |

## File register read/write instructions

### ■Reading 1-byte data from the file register

| Instruction symbol | Processing details                                                           | Reference         |
|--------------------|------------------------------------------------------------------------------|-------------------|
| ZRRDB              | Reads the data from the file register with the specified serial byte number. | Page 956 ZRRDB(P) |
| ZRRDBP             |                                                                              |                   |

### ■Writing 1-byte data to the file register

| Instruction symbol | Processing details                                                                                                    | Reference         |
|--------------------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| ZRWRB              | Writes the data in the lower bits of the specified device to the file register with the specified serial byte number. | Page 958 ZRWRB(P) |
| ZRWRBP             |                                                                                                                       |                   |

## Indirect address read instructions

### ■Reading the indirect address

| Instruction symbol | Processing details                                                  | Reference          |
|--------------------|---------------------------------------------------------------------|--------------------|
| ADRSET             | Reads the indirect address of the specified device.                 | Page 961 ADRSET(P) |
| ADRSETP            | <p>(1) Indirect address of specified device<br/>(2) Device name</p> |                    |

## Timer, counter

### Special counter instructions

#### ■Counting up or down the current value (1-phase input)

| Instruction symbol | Processing details                                                                                              | Reference       |
|--------------------|-----------------------------------------------------------------------------------------------------------------|-----------------|
| UDCNT1             | <p>Updates the current value of the specified counter.</p> <p>(1) Current value of Cn<br/>(2) Contact of Cn</p> | Page 963 UDCNT1 |

#### ■Counting up or down the current value (2-phase input)

| Instruction symbol | Processing details                                                                                                                                     | Reference       |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| UDCNT2             | <p>Updates the current value of the counter depending on the status of phases A and B pulses.</p> <p>(1) Current value of Cn<br/>(2) Contact of Cn</p> | Page 965 UDCNT2 |

## Special timer instructions

### ■Teaching timer

| Instruction symbol | Processing details                                                                                                                                                                                                                                       | Reference     |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| TTMR               | <p>Measures the on time of the measurement command in seconds, multiplies it by a multiplier, and stores the operation result.</p> $T_{ON} \times (s) \longrightarrow (d)$ <p>(s)=0:1, (s)=1:10, (s)=2:100<br/> <math>T_{ON}</math>: On time of TTMR</p> | Page 967 TTMR |

### ■Special function timer

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                                                                                                                                | Reference     |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| STMR               | <p>Performs the following operations at the four points from the bit device specified by (d) according to on/off of the input condition of the instruction.</p> <ul style="list-style-type: none"> <li>• (d)+0: Off delay timer output</li> <li>• (d)+1: After-off one-shot timer output</li> <li>• (d)+2: After-on one-shot timer output</li> <li>• (d)+3: On delay + off delay timer</li> </ul> | Page 969 STMR |



## Clock instructions

### ■Reading clock data

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                                                                                                                                                       | Reference |       |       |       |       |       |       |                    |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------|-------|-------|-------|-------|-------|--------------------|
| DATERD             | Reads "year, month, day, hour, minute, second, and day of week" from the clock element of the controller.<br><table border="1"><tr><td>(d)</td></tr><tr><td>(d)+1</td></tr><tr><td>(d)+2</td></tr><tr><td>(d)+3</td></tr><tr><td>(d)+4</td></tr><tr><td>(d)+5</td></tr><tr><td>(d)+6</td></tr></table><br>(d): Year<br>(d)+1: Month<br>(d)+2: Day<br>(d)+3: Hour<br>(d)+4: Minute<br>(d)+5: Second<br>(d)+6: Day of week | (d)       | (d)+1 | (d)+2 | (d)+3 | (d)+4 | (d)+5 | (d)+6 | Page 972 DATERD(P) |
| (d)                |                                                                                                                                                                                                                                                                                                                                                                                                                          |           |       |       |       |       |       |       |                    |
| (d)+1              |                                                                                                                                                                                                                                                                                                                                                                                                                          |           |       |       |       |       |       |       |                    |
| (d)+2              |                                                                                                                                                                                                                                                                                                                                                                                                                          |           |       |       |       |       |       |       |                    |
| (d)+3              |                                                                                                                                                                                                                                                                                                                                                                                                                          |           |       |       |       |       |       |       |                    |
| (d)+4              |                                                                                                                                                                                                                                                                                                                                                                                                                          |           |       |       |       |       |       |       |                    |
| (d)+5              |                                                                                                                                                                                                                                                                                                                                                                                                                          |           |       |       |       |       |       |       |                    |
| (d)+6              |                                                                                                                                                                                                                                                                                                                                                                                                                          |           |       |       |       |       |       |       |                    |
| DATERDP            |                                                                                                                                                                                                                                                                                                                                                                                                                          |           |       |       |       |       |       |       |                    |

### ■Writing clock data

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                                         | Reference          |     |       |       |       |       |       |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----|-------|-------|-------|-------|-------|
| DATEWR             | Writes the clock data stored in the specified device and later to the clock element of the controller.                                                                                                                                                                                                     | Page 974 DATEWR(P) |     |       |       |       |       |       |
| DATEWRP            | <table><tr><td>(s)</td></tr><tr><td>(s)+1</td></tr><tr><td>(s)+2</td></tr><tr><td>(s)+3</td></tr><tr><td>(s)+4</td></tr><tr><td>(s)+5</td></tr><tr><td>(s)+6</td></tr></table> <p>(s): Year<br/>(s)+1: Month<br/>(s)+2: Day<br/>(s)+3: Hour<br/>(s)+4: Minute<br/>(s)+5: Second<br/>(s)+6: Day of week</p> |                    | (s) | (s)+1 | (s)+2 | (s)+3 | (s)+4 | (s)+5 |
| (s)                |                                                                                                                                                                                                                                                                                                            |                    |     |       |       |       |       |       |
| (s)+1              |                                                                                                                                                                                                                                                                                                            |                    |     |       |       |       |       |       |
| (s)+2              |                                                                                                                                                                                                                                                                                                            |                    |     |       |       |       |       |       |
| (s)+3              |                                                                                                                                                                                                                                                                                                            |                    |     |       |       |       |       |       |
| (s)+4              |                                                                                                                                                                                                                                                                                                            |                    |     |       |       |       |       |       |
| (s)+5              |                                                                                                                                                                                                                                                                                                            |                    |     |       |       |       |       |       |
| (s)+6              |                                                                                                                                                                                                                                                                                                            |                    |     |       |       |       |       |       |

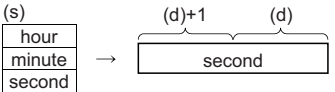
### ■Adding clock data

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                                                                             | Reference         |      |        |        |      |        |        |      |        |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------|--------|--------|------|--------|--------|------|--------|
| DATE+              | Adds time data.                                                                                                                                                                                                                                                                                                                                | Page 976 DATE+(P) |      |        |        |      |        |        |      |        |
| DATE+P             | <div><div>(s1)<table><tr><td>hour</td></tr><tr><td>minute</td></tr><tr><td>second</td></tr></table></div><div>+</div><div>(s2)<table><tr><td>hour</td></tr><tr><td>minute</td></tr><tr><td>second</td></tr></table></div><div>→</div><div>(d)<table><tr><td>hour</td></tr><tr><td>minute</td></tr><tr><td>second</td></tr></table></div></div> |                   | hour | minute | second | hour | minute | second | hour | minute |
| hour               |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| minute             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| second             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| hour               |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| minute             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| second             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| hour               |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| minute             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| second             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |

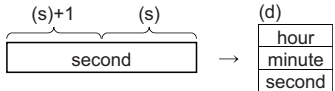
### ■Subtracting clock data

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                                                                             | Reference         |      |        |        |      |        |        |      |        |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------|--------|--------|------|--------|--------|------|--------|
| DATE-              | Subtracts time data.                                                                                                                                                                                                                                                                                                                           | Page 978 DATE-(P) |      |        |        |      |        |        |      |        |
| DATE-P             | <div><div>(s1)<table><tr><td>hour</td></tr><tr><td>minute</td></tr><tr><td>second</td></tr></table></div><div>-</div><div>(s2)<table><tr><td>hour</td></tr><tr><td>minute</td></tr><tr><td>second</td></tr></table></div><div>→</div><div>(d)<table><tr><td>hour</td></tr><tr><td>minute</td></tr><tr><td>second</td></tr></table></div></div> |                   | hour | minute | second | hour | minute | second | hour | minute |
| hour               |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| minute             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| second             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| hour               |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| minute             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| second             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| hour               |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| minute             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |
| second             |                                                                                                                                                                                                                                                                                                                                                |                   |      |        |        |      |        |        |      |        |

## ■Converting time data from hour/minute/second to second

| Instruction symbol | Processing details                                                                | Reference            |
|--------------------|-----------------------------------------------------------------------------------|----------------------|
| TIME2SEC           | Converts time data from hour/minute/second to second.                             | Page 980 TIME2SEC(P) |
| TIME2SECP          |  |                      |

## ■Converting time data from second to hour/minute/second

| Instruction symbol | Processing details                                                                | Reference            |
|--------------------|-----------------------------------------------------------------------------------|----------------------|
| SEC2TIME           | Converts time data from second to hour/minute/second.                             | Page 982 SEC2TIME(P) |
| SEC2TIMEP          |  |                      |

## ■Converting date and time data

| Instruction symbol | Processing details                                                                                                                                                                                                                                           | Reference                |       |       |      |        |        |             |             |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-------|-------|------|--------|--------|-------------|-------------|
| DATE2SEC           | Converts date and time data (year/month/day/time/minute/second) into second data.                                                                                                                                                                            | Page 984 DATE2SEC(P)(_U) |       |       |      |        |        |             |             |
| DATE2SECP          | (s)                                                                                                                                                                                                                                                          |                          |       |       |      |        |        |             |             |
| DATE2SEC_U         | <table><tr><td>year</td></tr></table>                                                                                                                                                                                                                        |                          | year  |       |      |        |        |             |             |
| year               |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| DATE2SECP_U        | <table><tr><td>month</td></tr><tr><td>day</td></tr><tr><td>hour</td></tr><tr><td>minute</td></tr><tr><td>second</td></tr></table> <div><div>(d)+1</div><div>(d)</div><div>second</div></div>                                                                 |                          | month | day   | hour | minute | second |             |             |
| month              |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| day                |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| hour               |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| minute             |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| second             |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
|                    |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| SEC2DATE           | Converts second data into date and time data (year/month/day/time/minute/second/day of week).                                                                                                                                                                | Page 986 SEC2DATE(P)(_U) |       |       |      |        |        |             |             |
| SEC2DATEP          | (d)                                                                                                                                                                                                                                                          |                          |       |       |      |        |        |             |             |
| SEC2DATE_U         | <table><tr><td>year</td></tr><tr><td>month</td></tr><tr><td>day</td></tr><tr><td>hour</td></tr><tr><td>minute</td></tr><tr><td>second</td></tr><tr><td>day of week</td></tr></table>                                                                         |                          | year  | month | day  | hour   | minute | second      | day of week |
| year               |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| month              |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| day                |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| hour               |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| minute             |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| second             |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| day of week        |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| SEC2DATEP_U        | <div><div>(s)+1</div><div>(s)</div><div>second</div></div> <div>→</div> <table><tr><td>year</td></tr><tr><td>month</td></tr><tr><td>day</td></tr><tr><td>hour</td></tr><tr><td>minute</td></tr><tr><td>second</td></tr><tr><td>day of week</td></tr></table> | year                     | month | day   | hour | minute | second | day of week |             |
| year               |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| month              |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| day                |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| hour               |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| minute             |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| second             |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
| day of week        |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |
|                    |                                                                                                                                                                                                                                                              |                          |       |       |      |        |        |             |             |

## ■Comparing date data

| Instruction symbol      | Processing details                                                                 | Reference                     |
|-------------------------|------------------------------------------------------------------------------------|-------------------------------|
| LDDT=, ANDDT=, ORDT=    | Compares the specified date data, or compares the date data with the current date. | Page 988 LDDT□, ANDDT□, ORDT□ |
| LDDT<>, ANDDT<>, ORDT<> |                                                                                    |                               |
| LDDT>, ANDDT>, ORDT>    |                                                                                    |                               |
| LDDT<=, ANDDT<=, ORDT<= |                                                                                    |                               |
| LDDT<, ANDDT<, ORDT<    |                                                                                    |                               |
| LDDT>=, ANDDT>=, ORDT>= |                                                                                    |                               |

## ■Comparing time data

| Instruction symbol      | Processing details                                                                           | Reference                     |
|-------------------------|----------------------------------------------------------------------------------------------|-------------------------------|
| LDTM=, ANDTM=, ORTM=    | Compares the specified time data, or compares the specified time data with the current time. | Page 992 LDTM□, ANDTM□, ORTM□ |
| LDTM<>, ANDTM<>, ORTM<> |                                                                                              |                               |
| LDTM>, ANDTM>, ORTM>    |                                                                                              |                               |
| LDTM<=, ANDTM<=, ORTM<= |                                                                                              |                               |
| LDTM<, ANDTM<, ORTM<    |                                                                                              |                               |
| LDTM>=, ANDTM>=, ORTM>= |                                                                                              |                               |

## ■Outputting a comparison result of time data

| Instruction symbol | Processing details                                                                                                                                                                                             | Reference        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| TCMP               | Compares the time data to be compared that is specified by (s1), (s2), and (s3) with the time data specified by (s4), and according to the result (small, match, or large), (d), (d)+1, or (d)+2 is turned on. | Page 995 TCMP(P) |
| TCMPP              |                                                                                                                                                                                                                |                  |

## ■Reading expansion clock data

| Instruction symbol | Processing details                                                                | Reference            |
|--------------------|-----------------------------------------------------------------------------------|----------------------|
| S.DATERD           | Reads clock data including millisecond from the clock elements in the controller. | Page 997 S(P).DATERD |
| SP.DATERD          |                                                                                   |                      |

|       |
|-------|
| (d)   |
| (d)+1 |
| (d)+2 |
| (d)+3 |
| (d)+4 |
| (d)+5 |
| (d)+6 |
| (d)+7 |

(d): Year  
(d)+1: Month  
(d)+2: Day  
(d)+3: Hour  
(d)+4: Minute  
(d)+5: Second  
(d)+6: Day of week  
(d)+7: Millisecond

## ■Adding expansion clock data

| Instruction symbol | Processing details | Reference           |
|--------------------|--------------------|---------------------|
| S.DATE+            | Adds time data.    | Page 999 S(P).DATE+ |
| SP.DATE+           |                    |                     |

|               |
|---------------|
| (s1)          |
| hour          |
| minute        |
| second        |
| —             |
| 1/1000 second |

+

|               |
|---------------|
| (s2)          |
| hour          |
| minute        |
| second        |
| —             |
| 1/1000 second |

→

|               |
|---------------|
| (d)           |
| hour          |
| minute        |
| second        |
| —             |
| 1/1000 second |

## ■Subtracting expansion clock data

| Instruction symbol | Processing details   | Reference            |
|--------------------|----------------------|----------------------|
| S.DATE-            | Subtracts time data. | Page 1001 S(P).DATE- |
| SP.DATE-           |                      |                      |

|               |
|---------------|
| (s1)          |
| hour          |
| minute        |
| second        |
| —             |
| 1/1000 second |

-

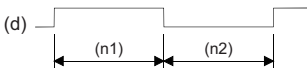
|               |
|---------------|
| (s2)          |
| hour          |
| minute        |
| second        |
| —             |
| 1/1000 second |

→

|               |
|---------------|
| (d)           |
| hour          |
| minute        |
| second        |
| —             |
| 1/1000 second |

## Timing check instructions

### ■Generating timing pulses

| Instruction symbol | Processing details                                                                                                                                                                                                                                                                     | Reference      |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| DUTY               | <p>Turns on the user timing clock for the specified number of scans and off for the specified number of scans.</p> <p>(d) </p> <p>(n1): (n1) scans<br/> (n2): (n2) scans<br/> (d): SM420 to SM424</p> | Page 1003 DUTY |

### ■Measuring time of the specified data

| Instruction symbol | Processing details                                                                                                                          | Reference        |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| TIMCHK             | Measures the on time of the input condition and, if the on time has continued as specified or longer, turns on the device specified by (d). | Page 1005 TIMCHK |

## Module access

### Module access instructions

#### ■Performing I/O refresh

| Instruction symbol | Processing details                                                     | Reference        |
|--------------------|------------------------------------------------------------------------|------------------|
| RFS                | Performs partial refresh of the relevant input/output during one scan. | Page 1007 RFS(P) |
| RFSP               |                                                                        |                  |

#### ■Reading 1-word/2-word data from another module (16-bit specification)

| Instruction symbol | Processing details                                                                                              | Reference                   |
|--------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------|
| FROM               | Reads (n) words of data in units of 16 bits from the buffer memory areas of the intelligent function modules.   | Page 1009 FROM(P), DFROM(P) |
| FROMP              |                                                                                                                 |                             |
| DFROM              | Reads (n)×2 words of data in units of 16 bits from the buffer memory areas of the intelligent function modules. |                             |
| DFROMP             |                                                                                                                 |                             |

#### ■Writing 1-word/2-word data to a module (16-bit specification)

| Instruction symbol | Processing details                                                                                            | Reference               |
|--------------------|---------------------------------------------------------------------------------------------------------------|-------------------------|
| TO                 | Writes (n) words of data in units of 16 bits to the buffer memory areas of the intelligent function module.   | Page 1012 TO(P), DTO(P) |
| TOP                |                                                                                                               |                         |
| DTO                | Writes (n)×2 words of data in units of 16 bits to the buffer memory areas of the intelligent function module. |                         |
| DTOP               |                                                                                                               |                         |

#### ■Reading 1-word/2-word data from another module (32-bit specification)

| Instruction symbol | Processing details                                                                                              | Reference                     |
|--------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------|
| FROMD              | Reads (n) words of data in units of 32 bits from the buffer memory areas of the intelligent function modules.   | Page 1017 FROMD(P), DFROMD(P) |
| FROMDP             |                                                                                                                 |                               |
| DFROMD             | Reads (n)×2 words of data in units of 32 bits from the buffer memory areas of the intelligent function modules. |                               |
| DFROMDP            |                                                                                                                 |                               |

#### ■Writing 1-word/2-word data to a module (32-bit specification)

| Instruction symbol | Processing details                                                                                            | Reference                 |
|--------------------|---------------------------------------------------------------------------------------------------------------|---------------------------|
| TOD                | Writes (n) words of data in units of 32 bits to the buffer memory areas of the intelligent function module.   | Page 1021 TOD(P), DTOD(P) |
| TODP               |                                                                                                               |                           |
| DTOD               | Writes (n)×2 words of data in units of 32 bits to the buffer memory areas of the intelligent function module. |                           |
| DTODP              |                                                                                                               |                           |

#### ■Reading module specific information

| Instruction symbol | Processing details                                                        | Reference             |
|--------------------|---------------------------------------------------------------------------|-----------------------|
| UNIINFRD           | Stores module information in the device areas specified by (d) and later. | Page 1025 UNIINFRD(P) |
| UNIINFRDP          |                                                                           |                       |

## PID operation instruction

| Instruction symbol | Processing details                                                                                                                  | Reference     |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------|---------------|
| PID                | Performs PID operation using the values set in (s1) to (s3), and stores the operation result in (d) at each cycle of sampling time. | Page 1041 PID |

## PID control instructions

### PID control instructions (inexact differential)

#### ■Registering the PID control data to the controller

| Instruction symbol | Processing details                                                                                                                                                      | Reference              |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| S.PIDINIT          | Stores the PID control data by the number of loops used that is set in the device number specified by (s) and later altogether in the controller to enable PID control. | Page 1056 S(P).PIDINIT |
| SP.PIDINIT         |                                                                                                                                                                         |                        |

#### ■Performing PID operation

| Instruction symbol | Processing details                                      | Reference              |
|--------------------|---------------------------------------------------------|------------------------|
| S.PIDCONT          | Measures the sampling cycle and performs PID operation. | Page 1059 S(P).PIDCONT |
| SP.PIDCONT         |                                                         |                        |

#### ■Stopping/starting the operation of specified loop number

| Instruction symbol | Processing details                                                          | Reference              |
|--------------------|-----------------------------------------------------------------------------|------------------------|
| S.PIDSTOP          | Stops the PID operation of the loop number in the device specified by (s).  | Page 1062 S(P).PIDSTOP |
| SP.PIDSTOP         |                                                                             |                        |
| S.PIDRUN           | Starts the PID operation of the loop number in the device specified by (s). | Page 1063 S(P).PIDRUN  |
| SP.PIDRUN          |                                                                             |                        |

#### ■Changing the parameters of specified loop number

| Instruction symbol | Processing details                                                                                                                                                  | Reference              |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| S.PIDPRMW          | Changes the operation parameter of the loop number in the device specified by (s1) to the PID control data stored in the device number specified by (s2) and later. | Page 1064 S(P).PIDPRMW |
| SP.PIDPRMW         |                                                                                                                                                                     |                        |

## PID control instructions (exact differential)

### ■Registering the PID control data to the controller

| Instruction symbol | Processing details                                                                                                                                                      | Reference            |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| PIDINIT            | Stores the PID control data by the number of loops used that is set in the device number specified by (s) and later altogether in the controller to enable PID control. | Page 1068 PIDINIT(P) |
| PIDINITP           |                                                                                                                                                                         |                      |

### ■Performing PID operation

| Instruction symbol | Processing details                                      | Reference            |
|--------------------|---------------------------------------------------------|----------------------|
| PIDCONT            | Measures the sampling cycle and performs PID operation. | Page 1070 PIDCONT(P) |
| PIDCONTP           |                                                         |                      |

### ■Stopping/starting the operation of specified loop number

| Instruction symbol | Processing details                                                          | Reference            |
|--------------------|-----------------------------------------------------------------------------|----------------------|
| PIDSTOP            | Stops the PID operation of the loop number in the device specified by (s).  | Page 1073 PIDSTOP(P) |
| PIDSTOPP           |                                                                             |                      |
| PIDRUN             | Starts the PID operation of the loop number in the device specified by (s). | Page 1074 PIDRUN(P)  |
| PIDRUNP            |                                                                             |                      |

### ■Changing the parameters of specified loop number

| Instruction symbol | Processing details                                                                                                                                                  | Reference            |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| PIDPRMW            | Changes the operation parameter of the loop number in the device specified by (s1) to the PID control data stored in the device number specified by (s2) and later. | Page 1075 PIDPRMW(P) |
| PIDPRMWP           |                                                                                                                                                                     |                      |

## High-speed I/O control instructions

### Starting/stopping high-speed I/O

| Instruction symbol | Processing details                                                     | Reference           |
|--------------------|------------------------------------------------------------------------|---------------------|
| HIOEN(P)           | Controls the start and stop operations of the high-speed I/O function. | Page 1077 HIOEN(P)  |
| DHIOEN(P)          |                                                                        | Page 1080 DHIOEN(P) |

## Dedicated instructions for the positioning function

### Mechanical OPR

| Instruction symbol | Processing details               | Reference            |
|--------------------|----------------------------------|----------------------|
| DSZR               | Executes mechanical zero return. | Page 1083 DSZR/DDSZR |
| DDSZR              |                                  |                      |

### Interrupt 1-speed positioning

| Instruction symbol | Processing details                                 | Reference            |
|--------------------|----------------------------------------------------|----------------------|
| DVIT               | Executes interrupt 1-speed constant quantity feed. | Page 1090 DVIT/DDVIT |
| DDVIT              |                                                    |                      |

### Variable speed operation

| Instruction symbol | Processing details                                            | Reference            |
|--------------------|---------------------------------------------------------------|----------------------|
| PLSV               | Outputs variable speed pulses with rotation direction output. | Page 1096 PLSV/DPLSV |
| DPLSV              |                                                               |                      |

### 1-speed positioning (relative)

| Instruction symbol | Processing details                                    | Reference            |
|--------------------|-------------------------------------------------------|----------------------|
| DRVI               | Executes 1-speed positioning with a relative address. | Page 1101 DRVI/DDRVI |
| DDRVI              |                                                       |                      |

### 1-speed positioning (absolute)

| Instruction symbol | Processing details                                     | Reference            |
|--------------------|--------------------------------------------------------|----------------------|
| DRVA               | Executes 1-speed positioning with an absolute address. | Page 1106 DRVA/DDRVA |
| DDRVA              |                                                        |                      |

### Table operation (multiple tables)

| Instruction symbol | Processing details                                                                                                                                  | Reference        |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| DRVTBL             | Executes continuous operation or stepping operation for multiple tables with one instruction based on the table data set with the engineering tool. | Page 1111 DRVTBL |

### Interrupt input 1 trigger

| Instruction symbol | Processing details                                                                                       | Reference       |
|--------------------|----------------------------------------------------------------------------------------------------------|-----------------|
| DITRG              | Generates a trigger equivalent to the input interrupt 1 signal for triggering without using an X device. | Page 1113 DITRG |

### Absolute position restoration

| Instruction symbol | Processing details                                                                                                                                                                                                 | Reference        |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| DABRST             | Reads the absolute position (ABS) data of a servo amplifier that supports the absolute position restoration function while the servo amplifier is being connected.<br>The data is converted into pulses when read. | Page 1116 DABRST |



## Dedicated instructions for the high-speed counter function

### 16-bit data read/write (update)

| Instruction symbol | Processing details                                                                                                               | Reference          |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------|--------------------|
| HCMOV(P)           | Reads and writes (updates) special relay/special register for high-speed counter, pulse width measurement, PWM, and positioning. | Page 1119 HCMOV(P) |

### 32-bit data read/write (update)

| Instruction symbol | Processing details                                                                                                               | Reference           |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------|
| DHCMOV(P)          | Reads and writes (updates) special relay/special register for high-speed counter, pulse width measurement, PWM, and positioning. | Page 1122 DHCMOV(P) |

## Pulse related instructions

### 16-bit binary pulse width modulation

| Instruction symbol | Processing details                                                                                                                                                            | Reference      |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| PWMH               | Outputs the ON time (in 16-bit data units) specified by (s1) and the pulse (in 16-bit data units) of the period specified by (s2) to the output destination specified by (d). | Page 1124 PWMH |

### 32-bit binary pulse width modulation

| Instruction symbol | Processing details                                                                                                                                                            | Reference       |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| DPWMH              | Outputs the ON time (in 32-bit data units) specified by (s1) and the pulse (in 32-bit data units) of the period specified by (s2) to the output destination specified by (d). | Page 1131 DPWMH |

### Measuring the density of 16-bit data pulses

| Instruction symbol | Processing details                                                    | Reference      |
|--------------------|-----------------------------------------------------------------------|----------------|
| SPDH               | Measures the input pulse for the specified time with interrupt input. | Page 1138 SPDH |

### Measuring the density of 32-bit data pulses

| Instruction symbol | Processing details                                                    | Reference       |
|--------------------|-----------------------------------------------------------------------|-----------------|
| DSPDH              | Measures the input pulse for the specified time with interrupt input. | Page 1141 DSPDH |

# 7

## NETWORK INSTRUCTION LIST

### 7.1 Ethernet Instructions

#### Open/close processing instructions

##### ■Opening a connection

| Instruction symbol | Processing details                      | Reference                        |
|--------------------|-----------------------------------------|----------------------------------|
| GP.SOCOPEN         | Opens the connection specified by (s1). | Page 1146 GP.SOCOPEN, SP.SOCOPEN |
| SP.SOCOPEN         |                                         |                                  |

##### ■Closing a connection

| Instruction symbol | Processing details                                              | Reference                          |
|--------------------|-----------------------------------------------------------------|------------------------------------|
| GP.SOCCLOSE        | Closes the connection specified by (s1). (Closing a connection) | Page 1150 GP.SOCCLOSE, SP.SOCCLOSE |
| SP.SOCCLOSE        |                                                                 |                                    |

#### Socket communications instructions

##### ■Reading receive data during the END processing

| Instruction symbol | Processing details                                                                                                                | Reference                      |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| GP.SOCRCV          | Reads the receive data of the connection specified by (s1) during END processing from the socket communication receive data area. | Page 1152 GP.SOCRCV, SP.SOCRCV |
| SP.SOCRCV          |                                                                                                                                   |                                |

##### ■Reading receive data when the instruction is executed

| Instruction symbol | Processing details                                                                                                                      | Reference                      |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| G.SOCRCVS          | Reads the receive data of the connection specified by (s) during instruction execution from the socket communication receive data area. | Page 1157 G.SOCRCVS, S.SOCRCVS |
| S.SOCRCVS          |                                                                                                                                         |                                |

##### ■Sending data

| Instruction symbol | Processing details                                                                                         | Reference                      |
|--------------------|------------------------------------------------------------------------------------------------------------|--------------------------------|
| GP.SOCSND          | Sends the data in the device specified by (s3) to the external device of the connection specified by (s1). | Page 1160 GP.SOCSND, SP.SOCSND |
| SP.SOCSND          |                                                                                                            |                                |

##### ■Reading connection information

| Instruction symbol | Processing details                                                    | Reference                        |
|--------------------|-----------------------------------------------------------------------|----------------------------------|
| GP.SOCCINF         | Reads the connection information of the connection specified by (s1). | Page 1164 GP.SOCCINF, SP.SOCCINF |
| SP.SOCCINF         |                                                                       |                                  |

##### ■Changing the communication target (UDP/IP)

| Instruction symbol | Processing details                                                                                                            | Reference                        |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| GP.SOCCSET         | Changes the communication target IP address and port number of the connection specified by (s1). (UDP/IP communications only) | Page 1167 GP.SOCCSET, SP.SOCCSET |
| SP.SOCCSET         |                                                                                                                               |                                  |

## ■Changing the receive mode

| Instruction symbol | Processing details                                                                           | Reference                          |
|--------------------|----------------------------------------------------------------------------------------------|------------------------------------|
| GP.SOCRMODE        | Changes the TCP/TLS receive mode and receive data size for the connection specified by (s1). | Page 1169 GP.SOCRMODE, SP.SOCRMODE |
| SP.SOCRMODE        |                                                                                              |                                    |

## ■Reading socket communications receive data

| Instruction symbol | Processing details                                                                                                                                                                                | Reference                            |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| G.SOCRDATA         | Reads data by the number of words specified by (n) from the socket communication receive data area of the connection specified by (s1), and stores them in the device specified by (d) and later. | Page 1174 G(P).SOCDATA, S(P).SOCDATA |
| GP.SOCRDATA        |                                                                                                                                                                                                   |                                      |
| S.SOCRDATA         |                                                                                                                                                                                                   |                                      |
| SP.SOCRDATA        |                                                                                                                                                                                                   |                                      |

## Predefined protocol support function instruction

### ■Executing the registered protocols

| Instruction symbol | Processing details                                                                                  | Reference                        |
|--------------------|-----------------------------------------------------------------------------------------------------|----------------------------------|
| GP.ECPRTCL         | Executes the protocol specified by the communication protocol support tool of the engineering tool. | Page 1176 GP.ECPRTCL, SP.ECPRTCL |
| SP.ECPRTCL         |                                                                                                     |                                  |

## SLMP frame send instruction

### ■Sending an SLMP frame

| Instruction symbol | Processing details                                 | Reference                                        |
|--------------------|----------------------------------------------------|--------------------------------------------------|
| G.SLMPSND          | Sends SLMP messages to the SLMP-compatible device. | Page 1184 G(P).SLMPSND, J(P).SLMPSND, SP.SLMPSND |
| GP.SLMPSND         |                                                    |                                                  |
| J.SLMPSND          |                                                    |                                                  |
| JP.SLMPSND         |                                                    |                                                  |
| SP.SLMPSND         |                                                    |                                                  |

### ■Sending an encrypted SLMP frame

| Instruction symbol | Processing details                                           | Reference               |
|--------------------|--------------------------------------------------------------|-------------------------|
| G.SLMPSNDC         | Sends encrypted SLMP messages to the SLMP-compatible device. | Page 1194 G(P).SLMPSNDC |
| GP.SLMPSNDC        |                                                              |                         |

## File transfer function instructions

### ■Sending FTP client files

| Instruction symbol | Processing details                                                                                                            | Reference                       |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| GP.FTPCPUT         | Sends files in the controller, which are specified by (s2), to the folder path of the FTP server, which is specified by (s3). | Page 1203 GP.FTPCPUT, SP.FTPPUT |
| SP.FTPPUT          |                                                                                                                               |                                 |

### ■Retrieving FTP client files

| Instruction symbol | Processing details                                                                                                                | Reference                       |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| GP.FTPCGET         | Retrieves files on the FTP server, which are specified by (s2), to the folder path of the controller, which is specified by (s3). | Page 1209 GP.FTPCGET, SP.FTPGET |
| SP.FTPGET          |                                                                                                                                   |                                 |

## 7.2 External Device Communication Instructions

### Special adapter instructions

| Instruction symbol | Processing details                                                                                                     | Reference       |
|--------------------|------------------------------------------------------------------------------------------------------------------------|-----------------|
| ADPRW              | Allows for communications (data read/write) with slave stations using function codes that are supported by the master. | Page 1215 ADPRW |

### Serial data transmission 2

| Instruction symbol | Processing details                                                                                           | Reference     |
|--------------------|--------------------------------------------------------------------------------------------------------------|---------------|
| RS2                | Sends/receives data by non-protocol communication via the communication adapter installed on the controller. | Page 1219 RS2 |

How to read the list is shown below.

| Item                                      | Description                                                    |
|-------------------------------------------|----------------------------------------------------------------|
| Function symbol and function block symbol | A function and function block name are shown.                  |
| Processing details                        | An overview of the functions and function blocks is explained. |
| Reference                                 | Indicates the reference of detailed information.               |

## 8.1 Standard Functions

### Type conversion functions

#### ■Converting BOOL to WORD/DWORD

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| BOOL_TO_WORD    | Converts a value from BOOL data type to WORD data type.  | Page 1222<br>BOOL_TO_WORD(_E)  |
| BOOL_TO_WORD_E  |                                                          |                                |
| BOOL_TO_DWORD   | Converts a value from BOOL data type to DWORD data type. | Page 1223<br>BOOL_TO_DWORD(_E) |
| BOOL_TO_DWORD_E |                                                          |                                |

#### ■Converting BOOL to INT/DINT

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| BOOL_TO_INT     | Converts a value from BOOL data type to INT data type.  | Page 1224 BOOL_TO_INT(_E)     |
| BOOL_TO_INT_E   |                                                         |                               |
| BOOL_TO_DINT    | Converts a value from BOOL data type to DINT data type. | Page 1225<br>BOOL_TO_DINT(_E) |
| BOOL_TO_DINT_E  |                                                         |                               |

#### ■Converting BOOL to TIME

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| BOOL_TO_TIME    | Converts a value from BOOL data type to TIME data type. | Page 1226<br>BOOL_TO_TIME(_E) |
| BOOL_TO_TIME_E  |                                                         |                               |

#### ■Converting BOOL to STRING

| Function symbol  | Processing details                                        | Reference                       |
|------------------|-----------------------------------------------------------|---------------------------------|
| BOOL_TO_STRING   | Converts a value from BOOL data type to STRING data type. | Page 1227<br>BOOL_TO_STRING(_E) |
| BOOL_TO_STRING_E |                                                           |                                 |

#### ■Converting WORD to BOOL

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| WORD_TO_BOOL    | Converts a value from WORD data type to BOOL data type. | Page 1228<br>WORD_TO_BOOL(_E) |
| WORD_TO_BOOL_E  |                                                         |                               |

#### ■Converting WORD to DWORD

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| WORD_TO_DWORD   | Converts a value from WORD data type to DWORD data type. | Page 1229<br>WORD_TO_DWORD(_E) |
| WORD_TO_DWORD_E |                                                          |                                |

## ■Converting WORD to INT/DINT

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| WORD_TO_INT     | Converts a value from WORD data type to INT data type.  | Page 1230<br>WORD_TO_INT(_E)  |
| WORD_TO_INT_E   |                                                         |                               |
| WORD_TO_DINT    | Converts a value from WORD data type to DINT data type. | Page 1231<br>WORD_TO_DINT(_E) |
| WORD_TO_DINT_E  |                                                         |                               |

## ■Converting WORD to TIME

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| WORD_TO_TIME    | Converts a value from WORD data type to TIME data type. | Page 1232<br>WORD_TO_TIME(_E) |
| WORD_TO_TIME_E  |                                                         |                               |

## ■Converting WORD to STRING

| Function symbol  | Processing details                                        | Reference                       |
|------------------|-----------------------------------------------------------|---------------------------------|
| WORD_TO_STRING   | Converts a value from WORD data type to STRING data type. | Page 1233<br>WORD_TO_STRING(_E) |
| WORD_TO_STRING_E |                                                           |                                 |

## ■Converting DWORD to BOOL

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| DWORD_TO_BOOL   | Converts a value from DWORD data type to BOOL data type. | Page 1234<br>DWORD_TO_BOOL(_E) |
| DWORD_TO_BOOL_E |                                                          |                                |

## ■Converting DWORD to WORD

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| DWORD_TO_WORD   | Converts a value from DWORD data type to WORD data type. | Page 1235<br>DWORD_TO_WORD(_E) |
| DWORD_TO_WORD_E |                                                          |                                |

## ■Converting DWORD to INT/DINT

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| DWORD_TO_INT    | Converts a value from DWORD data type to INT data type.  | Page 1237<br>DWORD_TO_INT(_E)  |
| DWORD_TO_INT_E  |                                                          |                                |
| DWORD_TO_DINT   | Converts a value from DWORD data type to DINT data type. | Page 1239<br>DWORD_TO_DINT(_E) |
| DWORD_TO_DINT_E |                                                          |                                |

## ■Converting DWORD to TIME

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| DWORD_TO_TIME   | Converts a value from DWORD data type to TIME data type. | Page 1240<br>DWORD_TO_TIME(_E) |
| DWORD_TO_TIME_E |                                                          |                                |

## ■Converting DWORD to STRING

| Function symbol   | Processing details                                         | Reference                        |
|-------------------|------------------------------------------------------------|----------------------------------|
| DWORD_TO_STRING   | Converts a value from DWORD data type to STRING data type. | Page 1241<br>DWORD_TO_STRING(_E) |
| DWORD_TO_STRING_E |                                                            |                                  |

## ■Converting INT to BOOL

| Function symbol | Processing details                                     | Reference                 |
|-----------------|--------------------------------------------------------|---------------------------|
| INT_TO_BOOL     | Converts a value from INT data type to BOOL data type. | Page 1242 INT_TO_BOOL(_E) |
| INT_TO_BOOL_E   |                                                        |                           |

## ■Converting INT to WORD/DWORD

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| INT_TO_WORD     | Converts a value from INT data type to WORD data type.  | Page 1243<br>INT_TO_WORD(_E)  |
| INT_TO_WORD_E   |                                                         |                               |
| INT_TO_DWORD    | Converts a value from INT data type to DWORD data type. | Page 1244<br>INT_TO_DWORD(_E) |
| INT_TO_DWORD_E  |                                                         |                               |

## ■Converting INT to DINT

| Function symbol | Processing details                                     | Reference                 |
|-----------------|--------------------------------------------------------|---------------------------|
| INT_TO_DINT     | Converts a value from INT data type to DINT data type. | Page 1245 INT_TO_DINT(_E) |
| INT_TO_DINT_E   |                                                        |                           |

## ■Converting INT to BCD

| Function symbol | Processing details                                    | Reference                |
|-----------------|-------------------------------------------------------|--------------------------|
| INT_TO_BCD      | Converts a value from INT data type to BCD data type. | Page 1246 INT_TO_BCD(_E) |
| INT_TO_BCD_E    |                                                       |                          |

## ■Converting INT to REAL/LREAL

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| INT_TO_REAL     | Converts a value from INT data type to REAL data type.  | Page 1248 INT_TO_REAL(_E)     |
| INT_TO_REAL_E   |                                                         |                               |
| INT_TO_LREAL    | Converts a value from INT data type to LREAL data type. | Page 1249<br>INT_TO_LREAL(_E) |
| INT_TO_LREAL_E  |                                                         |                               |

## ■Converting INT to TIME

| Function symbol | Processing details                                     | Reference                 |
|-----------------|--------------------------------------------------------|---------------------------|
| INT_TO_TIME     | Converts a value from INT data type to TIME data type. | Page 1250 INT_TO_TIME(_E) |
| INT_TO_TIME_E   |                                                        |                           |

## ■Converting INT to STRING

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| INT_TO_STRING   | Converts a value from INT data type to STRING data type. | Page 1251<br>INT_TO_STRING(_E) |
| INT_TO_STRING_E |                                                          |                                |

## ■Converting DINT to BOOL

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| DINT_TO_BOOL    | Converts a value from DINT data type to BOOL data type. | Page 1253<br>DINT_TO_BOOL(_E) |
| DINT_TO_BOOL_E  |                                                         |                               |

## ■Converting DINT to WORD/DWORD

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| DINT_TO_WORD    | Converts a value from DINT data type to WORD data type.  | Page 1254<br>DINT_TO_WORD(_E)  |
| DINT_TO_WORD_E  |                                                          |                                |
| DINT_TO_DWORD   | Converts a value from DINT data type to DWORD data type. | Page 1256<br>DINT_TO_DWORD(_E) |
| DINT_TO_DWORD_E |                                                          |                                |

## ■Converting DINT to INT

| Function symbol | Processing details                                     | Reference                 |
|-----------------|--------------------------------------------------------|---------------------------|
| DINT_TO_INT     | Converts a value from DINT data type to INT data type. | Page 1257 DINT_TO_INT(_E) |
| DINT_TO_INT_E   |                                                        |                           |

## ■Converting DINT to BCD

| Function symbol | Processing details                                     | Reference                 |
|-----------------|--------------------------------------------------------|---------------------------|
| DINT_TO_BCD     | Converts a value from DINT data type to BCD data type. | Page 1258 DINT_TO_BCD(_E) |
| DINT_TO_BCD_E   |                                                        |                           |

## ■Converting DINT to REAL/LREAL

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| DINT_TO_REAL    | Converts a value from DINT data type to REAL data type.  | Page 1260<br>DINT_TO_REAL(_E)  |
| DINT_TO_REAL_E  |                                                          |                                |
| DINT_TO_LREAL   | Converts a value from DINT data type to LREAL data type. | Page 1261<br>DINT_TO_LREAL(_E) |
| DINT_TO_LREAL_E |                                                          |                                |

## ■Converting DINT to TIME

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| DINT_TO_TIME    | Converts a value from DINT data type to TIME data type. | Page 1262<br>DINT_TO_TIME(_E) |
| DINT_TO_TIME_E  |                                                         |                               |

## ■Converting DINT to STRING

| Function symbol  | Processing details                                        | Reference                       |
|------------------|-----------------------------------------------------------|---------------------------------|
| DINT_TO_STRING   | Converts a value from DINT data type to STRING data type. | Page 1263<br>DINT_TO_STRING(_E) |
| DINT_TO_STRING_E |                                                           |                                 |

## ■Converting BCD to INT/DINT

| Function symbol | Processing details                                     | Reference                 |
|-----------------|--------------------------------------------------------|---------------------------|
| BCD_TO_INT      | Converts a value from BCD data type to INT data type.  | Page 1265 BCD_TO_INT(_E)  |
| BCD_TO_INT_E    |                                                        |                           |
| BCD_TO_DINT     | Converts a value from BCD data type to DINT data type. | Page 1267 BCD_TO_DINT(_E) |
| BCD_TO_DINT_E   |                                                        |                           |

## ■Converting BCD to STRING

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| BCD_TO_STRING   | Converts a value from BCD data type to STRING data type. | Page 1270<br>BCD_TO_STRING(_E) |
| BCD_TO_STRING_E |                                                          |                                |

## ■Converting REAL to INT/DINT

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| REAL_TO_INT     | Converts a value from REAL data type to INT data type.  | Page 1272 REAL_TO_INT(_E)     |
| REAL_TO_INT_E   |                                                         |                               |
| REAL_TO_DINT    | Converts a value from REAL data type to DINT data type. | Page 1274<br>REAL_TO_DINT(_E) |
| REAL_TO_DINT_E  |                                                         |                               |

## ■Converting REAL to LREAL

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| REAL_TO_LREAL   | Converts a value from REAL data type to LREAL data type. | Page 1276<br>REAL_TO_LREAL(_E) |
| REAL_TO_LREAL_E |                                                          |                                |

## ■Converting REAL to STRING

| Function symbol  | Processing details                                                      | Reference                       |
|------------------|-------------------------------------------------------------------------|---------------------------------|
| REAL_TO_STRING   | Converts a REAL data type value to STRING data type (exponential form). | Page 1278<br>REAL_TO_STRING(_E) |
| REAL_TO_STRING_E |                                                                         |                                 |



### ■Converting LREAL to INT/DINT

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| LREAL_TO_INT    | Converts a value from LREAL data type to INT data type.  | Page 1281<br>LREAL_TO_INT(_E)  |
| LREAL_TO_INT_E  |                                                          |                                |
| LREAL_TO_DINT   | Converts a value from LREAL data type to DINT data type. | Page 1282<br>LREAL_TO_DINT(_E) |
| LREAL_TO_DINT_E |                                                          |                                |

### ■Converting LREAL to REAL

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| LREAL_TO_REAL   | Converts a value from LREAL data type to REAL data type. | Page 1283<br>LREAL_TO_REAL(_E) |
| LREAL_TO_REAL_E |                                                          |                                |

### ■Converting TIME to BOOL

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| TIME_TO_BOOL    | Converts a value from TIME data type to BOOL data type. | Page 1284<br>TIME_TO_BOOL(_E) |
| TIME_TO_BOOL_E  |                                                         |                               |

### ■Converting TIME to WORD/DWORD

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| TIME_TO_WORD    | Converts a value from TIME data type to WORD data type.  | Page 1285<br>TIME_TO_WORD(_E)  |
| TIME_TO_WORD_E  |                                                          |                                |
| TIME_TO_DWORD   | Converts a value from TIME data type to DWORD data type. | Page 1286<br>TIME_TO_DWORD(_E) |
| TIME_TO_DWORD_E |                                                          |                                |

### ■Converting TIME to INT/DINT

| Function symbol | Processing details                                      | Reference                     |
|-----------------|---------------------------------------------------------|-------------------------------|
| TIME_TO_INT     | Converts a value from TIME data type to INT data type.  | Page 1287<br>TIME_TO_INT(_E)  |
| TIME_TO_INT_E   |                                                         |                               |
| TIME_TO_DINT    | Converts a value from TIME data type to DINT data type. | Page 1288<br>TIME_TO_DINT(_E) |
| TIME_TO_DINT_E  |                                                         |                               |

### ■Converting TIME to STRING

| Function symbol  | Processing details                                        | Reference                       |
|------------------|-----------------------------------------------------------|---------------------------------|
| TIME_TO_STRING   | Converts a value from TIME data type to STRING data type. | Page 1289<br>TIME_TO_STRING(_E) |
| TIME_TO_STRING_E |                                                           |                                 |

### ■Converting STRING to BOOL

| Function symbol  | Processing details                                        | Reference                       |
|------------------|-----------------------------------------------------------|---------------------------------|
| STRING_TO_BOOL   | Converts a value from STRING data type to BOOL data type. | Page 1291<br>STRING_TO_BOOL(_E) |
| STRING_TO_BOOL_E |                                                           |                                 |

### ■Converting STRING to WORD/DWORD

| Function symbol   | Processing details                                         | Reference                        |
|-------------------|------------------------------------------------------------|----------------------------------|
| STRING_TO_WORD    | Converts a value from STRING data type to WORD data type.  | Page 1292<br>STRING_TO_WORD(_E)  |
| STRING_TO_WORD_E  |                                                            |                                  |
| STRING_TO_DWORD   | Converts a value from STRING data type to DWORD data type. | Page 1293<br>STRING_TO_DWORD(_E) |
| STRING_TO_DWORD_E |                                                            |                                  |

## ■Converting STRING to INT/DINT

| Function symbol  | Processing details                                        | Reference                       |
|------------------|-----------------------------------------------------------|---------------------------------|
| STRING_TO_INT    | Converts a value from STRING data type to INT data type.  | Page 1294<br>STRING_TO_INT(_E)  |
| STRING_TO_INT_E  |                                                           |                                 |
| STRING_TO_DINT   | Converts a value from STRING data type to DINT data type. | Page 1296<br>STRING_TO_DINT(_E) |
| STRING_TO_DINT_E |                                                           |                                 |

## ■Converting STRING to BCD

| Function symbol | Processing details                                       | Reference                      |
|-----------------|----------------------------------------------------------|--------------------------------|
| STRING_TO_BCD   | Converts a value from STRING data type to BCD data type. | Page 1298<br>STRING_TO_BCD(_E) |
| STRING_TO_BCD_E |                                                          |                                |

## ■Converting STRING to REAL

| Function symbol  | Processing details                                        | Reference                       |
|------------------|-----------------------------------------------------------|---------------------------------|
| STRING_TO_REAL   | Converts a value from STRING data type to REAL data type. | Page 1300<br>STRING_TO_REAL(_E) |
| STRING_TO_REAL_E |                                                           |                                 |

## ■Converting STRING to TIME

| Function symbol  | Processing details                                        | Reference                       |
|------------------|-----------------------------------------------------------|---------------------------------|
| STRING_TO_TIME   | Converts a value from STRING data type to TIME data type. | Page 1303<br>STRING_TO_TIME(_E) |
| STRING_TO_TIME_E |                                                           |                                 |

## ■Converting bit array to INT/DINT

| Function symbol  | Processing details                                                              | Reference                       |
|------------------|---------------------------------------------------------------------------------|---------------------------------|
| BITARR_TO_INT    | Converts the specified number of bits in a bit array to an INT data type value. | Page 1304<br>BITARR_TO_INT(_E)  |
| BITARR_TO_INT_E  |                                                                                 |                                 |
| BITARR_TO_DINT   | Converts the specified number of bits in a bit array to a DINT data type value. | Page 1305<br>BITARR_TO_DINT(_E) |
| BITARR_TO_DINT_E |                                                                                 |                                 |

## ■Converting INT/DINT to bit array

| Function symbol  | Processing details                                                     | Reference                       |
|------------------|------------------------------------------------------------------------|---------------------------------|
| INT_TO_BITARR    | Outputs the lower n bits of the INT data type value to the bit array.  | Page 1306<br>INT_TO_BITARR(_E)  |
| INT_TO_BITARR_E  |                                                                        |                                 |
| DINT_TO_BITARR   | Outputs the lower n bits of the DINT data type value to the bit array. | Page 1307<br>DINT_TO_BITARR(_E) |
| DINT_TO_BITARR_E |                                                                        |                                 |

## ■Copying the bit array

| Function symbol | Processing details                                    | Reference                   |
|-----------------|-------------------------------------------------------|-----------------------------|
| CPY_BITARR      | Copies the bit array by the specified number of bits. | Page 1308<br>CPY_BITARR(_E) |
| CPY_BITARR_E    |                                                       |                             |

## ■Reading/writing/copying the specified bit of the word label

| Function symbol  | Processing details                                                                     | Reference                       |
|------------------|----------------------------------------------------------------------------------------|---------------------------------|
| GET_BIT_OF_INT   | Reads a value from the specified bit of a word label.                                  | Page 1309<br>GET_BIT_OF_INT(_E) |
| GET_BIT_OF_INT_E |                                                                                        |                                 |
| SET_BIT_OF_INT   | Writes a value to the specified bit of a word label.                                   | Page 1311<br>SET_BIT_OF_INT(_E) |
| SET_BIT_OF_INT_E |                                                                                        |                                 |
| CPY_BIT_OF_INT   | Copies the specified bit of the word label to the specified bit of another word label. | Page 1313<br>CPY_BIT_OF_INT(_E) |
| CPY_BIT_OF_INT_E |                                                                                        |                                 |

## ■Getting the start data

| Function symbol | Processing details                                                              | Reference                                                     |
|-----------------|---------------------------------------------------------------------------------|---------------------------------------------------------------|
| GET_BOOL_ADDR   | Outputs the top data of the specified data as the BOOL, INT, or WORD type data. | Page 1315<br>GET_BOOL_ADDR,<br>GET_INT_ADDR,<br>GET_WORD_ADDR |
| GET_INT_ADDR    |                                                                                 |                                                               |
| GET_WORD_ADDR   |                                                                                 |                                                               |

## Single variable functions

### ■Calculating the absolute value

| Function symbol | Processing details                            | Reference         |
|-----------------|-----------------------------------------------|-------------------|
| ABS             | Outputs the absolute value of an input value. | Page 1316 ABS(_E) |
| ABS_E           |                                               |                   |

### ■Calculating the square root

| Function symbol | Processing details                            | Reference          |
|-----------------|-----------------------------------------------|--------------------|
| SQRT            | Calculates the square root of an input value. | Page 1318 SQRT(_E) |
| SQRT_E          |                                               |                    |

### ■Calculating the natural logarithm

| Function symbol | Processing details                                                       | Reference        |
|-----------------|--------------------------------------------------------------------------|------------------|
| LN              | Outputs the natural logarithm (logarithm with base e) of an input value. | Page 1319 LN(_E) |
| LN_E            |                                                                          |                  |

### ■Calculating the common logarithm

| Function symbol | Processing details                                                       | Reference         |
|-----------------|--------------------------------------------------------------------------|-------------------|
| LOG             | Outputs the common logarithm (logarithm with base 10) of an input value. | Page 1320 LOG(_E) |
| LOG_E           |                                                                          |                   |

### ■Calculating the exponent

| Function symbol | Processing details                      | Reference         |
|-----------------|-----------------------------------------|-------------------|
| EXP             | Outputs the exponent of an input value. | Page 1322 EXP(_E) |
| EXP_E           |                                         |                   |

### ■Calculating the sine/cosine/tangent

| Function symbol | Processing details                     | Reference         |
|-----------------|----------------------------------------|-------------------|
| SIN             | Outputs the sine of an input value.    | Page 1323 SIN(_E) |
| SIN_E           |                                        |                   |
| COS             | Outputs the cosine of an input value.  | Page 1324 COS(_E) |
| COS_E           |                                        |                   |
| TAN             | Outputs the tangent of an input value. | Page 1325 TAN(_E) |
| TAN_E           |                                        |                   |

### ■Calculating the arc sine/arc cosine/arc tangent

| Function symbol | Processing details                                               | Reference          |
|-----------------|------------------------------------------------------------------|--------------------|
| ASIN            | Outputs the arc sine ( $\text{SIN}^{-1}$ ) of an input value.    | Page 1326 ASIN(_E) |
| ASIN_E          |                                                                  |                    |
| ACOS            | Outputs the arc cosine ( $\text{COS}^{-1}$ ) of an input value.  | Page 1327 ACOS(_E) |
| ACOS_E          |                                                                  |                    |
| ATAN            | Outputs the arc tangent ( $\text{TAN}^{-1}$ ) of an input value. | Page 1328 ATAN(_E) |
| ATAN_E          |                                                                  |                    |

## Arithmetic operation functions

### ■ Addition

| Function symbol | Processing details                                          | Reference         |
|-----------------|-------------------------------------------------------------|-------------------|
| ADD             | Outputs the sum of input values $((s1)+(s2)+\dots+(s28))$ . | Page 1329 ADD(_E) |
| ADD_E           |                                                             |                   |

### ■ Multiplication

| Function symbol | Processing details                                                             | Reference         |
|-----------------|--------------------------------------------------------------------------------|-------------------|
| MUL             | Outputs the product of input values $((s1)\times(s2)\times\dots\times(s28))$ . | Page 1332 MUL(_E) |
| MUL_E           |                                                                                |                   |

### ■ Subtraction

| Function symbol | Processing details                                          | Reference         |
|-----------------|-------------------------------------------------------------|-------------------|
| SUB             | Outputs the difference between input values $((s1)-(s2))$ . | Page 1335 SUB(_E) |
| SUB_E           |                                                             |                   |

### ■ Division

| Function symbol | Processing details                                      | Reference         |
|-----------------|---------------------------------------------------------|-------------------|
| DIV             | Outputs the quotient of input values $((s1)\div(s2))$ . | Page 1338 DIV(_E) |
| DIV_E           |                                                         |                   |

### ■ Remainder

| Function symbol | Processing details                                       | Reference         |
|-----------------|----------------------------------------------------------|-------------------|
| MOD             | Outputs the remainder of input values $((s1)\div(s2))$ . | Page 1340 MOD(_E) |
| MOD_E           |                                                          |                   |

### ■ Exponentiation

| Function symbol | Processing details                            | Reference          |
|-----------------|-----------------------------------------------|--------------------|
| EXPT            | Outputs the exponentiation of an input value. | Page 1342 EXPT(_E) |
| EXPT_E          |                                               |                    |

### ■ Assignment (move operation)

| Function symbol | Processing details                              | Reference          |
|-----------------|-------------------------------------------------|--------------------|
| MOVE            | Outputs the assignment value of an input value. | Page 1344 MOVE(_E) |
| MOVE_E          |                                                 |                    |

## Bit shift functions

### ■ Shifting data to the left/right by n bit(s)

| Function symbol | Processing details                                                                   | Reference         |
|-----------------|--------------------------------------------------------------------------------------|-------------------|
| SHL             | Shifts the input value to the left by (n) bit(s), and outputs the operation result.  | Page 1346 SHL(_E) |
| SHL_E           |                                                                                      |                   |
| SHR             | Shifts the input value to the right by (n) bit(s), and outputs the operation result. | Page 1348 SHR(_E) |
| SHR_E           |                                                                                      |                   |

### ■ Rotating data to the left/right by n bit(s)

| Function symbol | Processing details                                                                    | Reference         |
|-----------------|---------------------------------------------------------------------------------------|-------------------|
| ROL             | Rotates the input value to the left by (n) bit(s), and outputs the operation result.  | Page 1350 ROL(_E) |
| ROL_E           |                                                                                       |                   |
| ROR             | Rotates the input value to the right by (n) bit(s), and outputs the operation result. | Page 1352 ROR(_E) |
| ROR_E           |                                                                                       |                   |

## Boolean functions

### ■AND operation, OR operation, XOR operation

| Function symbol | Processing details                                 | Reference                          |
|-----------------|----------------------------------------------------|------------------------------------|
| AND             | Outputs the logical product of input values.       | Page 1354 AND(_E), OR(_E), XOR(_E) |
| AND_E           |                                                    |                                    |
| OR              | Outputs the logical sum of input values.           |                                    |
| OR_E            |                                                    |                                    |
| XOR             | Outputs the exclusive logical sum of input values. |                                    |
| XOR_E           |                                                    |                                    |

### ■NOT operation

| Function symbol | Processing details                       | Reference         |
|-----------------|------------------------------------------|-------------------|
| NOT             | Outputs the logical NOT of input values. | Page 1357 NOT(_E) |
| NOT_E           |                                          |                   |

## Selection functions

### ■Selecting a value

| Function symbol | Processing details                | Reference         |
|-----------------|-----------------------------------|-------------------|
| SEL             | Outputs the selected input value. | Page 1358 SEL(_E) |
| SEL_E           |                                   |                   |

### ■Selecting the maximum/minimum value

| Function symbol | Processing details               | Reference                  |
|-----------------|----------------------------------|----------------------------|
| MAX             | Outputs the maximum input value. | Page 1360 MAX(_E), MIN(_E) |
| MAX_E           |                                  |                            |
| MIN             | Outputs the minimum input value. |                            |
| MIN_E           |                                  |                            |

### ■Controlling the upper/lower limit

| Function symbol | Processing details                                                                      | Reference           |
|-----------------|-----------------------------------------------------------------------------------------|---------------------|
| LIMIT           | Outputs an input value that has been controlled in terms of the upper and lower limits. | Page 1362 LIMIT(_E) |
| LIMIT_E         |                                                                                         |                     |

### ■Multiplexer

| Function symbol | Processing details               | Reference         |
|-----------------|----------------------------------|-------------------|
| MUX             | Outputs one of the input values. | Page 1365 MUX(_E) |
| MUX_E           |                                  |                   |

## Comparison functions

### ■Comparing data

| Function symbol | Processing details                             | Reference                                        |
|-----------------|------------------------------------------------|--------------------------------------------------|
| GT              | Outputs the comparison result of input values. | Page 1367 GT(_E), GE(_E), EQ(_E), LE(_E), LT(_E) |
| GT_E            |                                                |                                                  |
| GE              |                                                |                                                  |
| GE_E            |                                                |                                                  |
| EQ              |                                                |                                                  |
| EQ_E            |                                                |                                                  |
| LE              |                                                |                                                  |
| LE_E            |                                                |                                                  |
| LT              |                                                |                                                  |
| LT_E            |                                                |                                                  |
| NE              |                                                | Page 1369 NE(_E)                                 |
| NE_E            |                                                |                                                  |

## String functions

### ■Detecting a string length

| Function symbol | Processing details                                  | Reference         |
|-----------------|-----------------------------------------------------|-------------------|
| LEN             | Detects and outputs the length of the string input. | Page 1371 LEN(_E) |
| LEN_E           |                                                     |                   |

### ■Extracting string data from the left/right

| Function symbol | Processing details                                                                                        | Reference                     |
|-----------------|-----------------------------------------------------------------------------------------------------------|-------------------------------|
| LEFT            | Extracts and outputs the specified number of characters, starting from the left end of the string input.  | Page 1373 LEFT(_E), RIGHT(_E) |
| LEFT_E          |                                                                                                           |                               |
| RIGHT           | Extracts and outputs the specified number of characters, starting from the right end of the string input. |                               |
| RIGHT_E         |                                                                                                           |                               |

### ■Extracting string data

| Function symbol | Processing details                                                                                                 | Reference         |
|-----------------|--------------------------------------------------------------------------------------------------------------------|-------------------|
| MID             | Extracts and outputs the specified number of characters, starting from the specified position of the string input. | Page 1376 MID(_E) |
| MID_E           |                                                                                                                    |                   |

### ■Concatenating string data

| Function symbol | Processing details                                      | Reference            |
|-----------------|---------------------------------------------------------|----------------------|
| CONCAT          | Concatenates strings, and outputs the operation result. | Page 1378 CONCAT(_E) |
| CONCAT_E        |                                                         |                      |

### ■Inserting string data

| Function symbol | Processing details                                                      | Reference            |
|-----------------|-------------------------------------------------------------------------|----------------------|
| INSERT          | Inserts a string into another string, and outputs the operation result. | Page 1380 INSERT(_E) |
| INSERT_E        |                                                                         |                      |

### ■Deleting string data

| Function symbol | Processing details                                                         | Reference            |
|-----------------|----------------------------------------------------------------------------|----------------------|
| DELETE          | Deletes the specified range in a string, and outputs the operation result. | Page 1382 DELETE(_E) |
| DELETE_E        |                                                                            |                      |

## ■Replacing string data

| Function symbol | Processing details                                                          | Reference             |
|-----------------|-----------------------------------------------------------------------------|-----------------------|
| REPLACE         | Replaces the specified range in a string, and outputs the operation result. | Page 1384 REPLACE(_E) |
| REPLACE_E       |                                                                             |                       |

## ■Searching string data

| Function symbol | Processing details                                   | Reference          |
|-----------------|------------------------------------------------------|--------------------|
| FIND            | Searches a string, and outputs the operation result. | Page 1387 FIND(_E) |
| FIND_E          |                                                      |                    |

## Time data type functions

### ■Addition

| Function symbol | Processing details                                                | Reference              |
|-----------------|-------------------------------------------------------------------|------------------------|
| ADD_TIME        | Outputs the sum $((s1)+(s2))$ of the TIME data type input values. | Page 1389 ADD_TIME(_E) |
| ADD_TIME_E      |                                                                   |                        |

### ■Subtraction

| Function symbol | Processing details                                                            | Reference              |
|-----------------|-------------------------------------------------------------------------------|------------------------|
| SUB_TIME        | Outputs the difference $((s1)-(s2))$ between the TIME data type input values. | Page 1391 SUB_TIME(_E) |
| SUB_TIME_E      |                                                                               |                        |

### ■Multiplication

| Function symbol | Processing details                                                         | Reference              |
|-----------------|----------------------------------------------------------------------------|------------------------|
| MUL_TIME        | Outputs the product $((s1)\times(s2))$ of the TIME data type input values. | Page 1393 MUL_TIME(_E) |
| MUL_TIME_E      |                                                                            |                        |

### ■Division

| Function symbol | Processing details                                                        | Reference              |
|-----------------|---------------------------------------------------------------------------|------------------------|
| DIV_TIME        | Outputs the quotient $((s1)\div(s2))$ of the TIME data type input values. | Page 1395 DIV_TIME(_E) |
| DIV_TIME_E      |                                                                           |                        |

## 8.2 Standard Function Blocks

### Bistable function blocks

#### ■ Bistable function block (set-dominant)

| Function block symbol | Processing details                                                        | Reference        |
|-----------------------|---------------------------------------------------------------------------|------------------|
| SR                    | Discriminates between two input values, and outputs1 (TRUE) or 0 (FALSE). | Page 1398 SR(_E) |
| SR_E                  |                                                                           |                  |

#### ■ Bistable function block (reset-dominant)

| Function block symbol | Processing details                                                        | Reference        |
|-----------------------|---------------------------------------------------------------------------|------------------|
| RS                    | Discriminates between two input values, and outputs1 (TRUE) or 0 (FALSE). | Page 1400 RS(_E) |
| RS_E                  |                                                                           |                  |

### Edge detection function blocks

#### ■ Detecting a rising edge

| Function block symbol | Processing details                                          | Reference            |
|-----------------------|-------------------------------------------------------------|----------------------|
| R_TRIG                | Detects a signal rising edge, and outputs the pulse signal. | Page 1402 R_TRIG(_E) |
| R_TRIG_E              |                                                             |                      |

#### ■ Detecting a falling edge

| Function block symbol | Processing details                                           | Reference            |
|-----------------------|--------------------------------------------------------------|----------------------|
| F_TRIG                | Detects a signal falling edge, and outputs the pulse signal. | Page 1404 F_TRIG(_E) |
| F_TRIG_E              |                                                              |                      |

### Counter function blocks

#### ■ Up counter

| Function block symbol | Processing details                                | Reference         |
|-----------------------|---------------------------------------------------|-------------------|
| CTU                   | Counts up the number of rising edges of a signal. | Page 1406 CTU(_E) |
| CTU_E                 |                                                   |                   |

#### ■ Down counter

| Function block symbol | Processing details                                  | Reference         |
|-----------------------|-----------------------------------------------------|-------------------|
| CTD                   | Counts down the number of rising edges of a signal. | Page 1408 CTD(_E) |
| CTD_E                 |                                                     |                   |

#### ■ Up/down counter

| Function block symbol | Processing details                                        | Reference          |
|-----------------------|-----------------------------------------------------------|--------------------|
| CTUD                  | Counts up or down the number of rising edges of a signal. | Page 1410 CTUD(_E) |
| CTUD_E                |                                                           |                    |

#### ■ Counter function block

| Function block symbol | Processing details                                            | Reference              |
|-----------------------|---------------------------------------------------------------|------------------------|
| COUNTER_FB_M          | Starts counting up when the execution condition is satisfied. | Page 1413 COUNTER_FB_M |



## Timer function blocks

### ■Pulse timer

| Function block symbol | Processing details                                    | Reference        |
|-----------------------|-------------------------------------------------------|------------------|
| TP                    | Keeps the signal on for the specified period of time. | Page 1415 TP(_E) |
| TP_E                  |                                                       |                  |

### ■On delay timer

| Function block symbol | Processing details                                    | Reference         |
|-----------------------|-------------------------------------------------------|-------------------|
| TON                   | Turns on a signal after the specified period of time. | Page 1418 TON(_E) |
| TON_E                 |                                                       |                   |

### ■Off delay timer

| Function block symbol | Processing details                                     | Reference         |
|-----------------------|--------------------------------------------------------|-------------------|
| TOF                   | Turns off a signal after the specified period of time. | Page 1420 TOF(_E) |
| TOF_E                 |                                                        |                   |

### ■Timer function block

| Function block symbol | Processing details                                                                                                               | Reference           |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------|
| TIMER_10_FB_M         | Starts counting a timer when the execution condition is satisfied, and continues counting until the timer reaches the set value. | Page 1422 TIMER_□_M |
| TIMER_100_FB_M        |                                                                                                                                  |                     |
| TIMER_HIGH_FB_M       |                                                                                                                                  |                     |
| TIMER_LOW_FB_M        |                                                                                                                                  |                     |
| TIMER_CONT_FB_M       |                                                                                                                                  |                     |
| TIMER_CONTHFB_M       |                                                                                                                                  |                     |

This chapter describes how to read the list.

| Item                  | Description                                  |
|-----------------------|----------------------------------------------|
| Function block symbol | Shows the function block name.               |
| Processing details    | Shows an overview of the function block.     |
| Reference             | Shows the reference of detailed information. |

For an overview on the motion control function block, refer to the following.

 Page 1428 MOTION CONTROL FB OVERVIEW

## 9.1 Administrative Function Blocks

The list of administrative motion control function blocks is shown below.

### Axes Group Enabled

| Function block symbol | Processing details                                                                                                    | Reference                    |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------|
| MC_GroupEnable        | Changes the specified Axes group status from "0: Axes group disabled (GroupDisabled)" to "4: Standby (GroupStandby)". | Page 1528 Axes Group Enabled |

### Axes Group Disabled

| Function block symbol | Processing details                                                                   | Reference                     |
|-----------------------|--------------------------------------------------------------------------------------|-------------------------------|
| MC_GroupDisable       | Changes the specified axes group status to "0: Axes group disabled (GroupDisabled)". | Page 1532 Axes Group Disabled |

### Operation Available

| Function block symbol | Processing details                                           | Reference          |
|-----------------------|--------------------------------------------------------------|--------------------|
| MC_Power              | Switches a specified axis to the operation available status. | Page 1536 Operable |

### Current Position Change

| Function block symbol | Processing details                                                                        | Reference                         |
|-----------------------|-------------------------------------------------------------------------------------------|-----------------------------------|
| MC_SetPosition        | Changes the current position (commanded position, actual position) of the specified axis. | Page 1540 Current Position Change |

### Torque Limit Value

| Function block symbol | Processing details            | Reference                    |
|-----------------------|-------------------------------|------------------------------|
| MCv_SetTorqueLimit    | Changes a torque limit value. | Page 1548 Torque Limit Value |

### Override Value Setting

| Function block symbol | Processing details                                                                                       | Reference                        |
|-----------------------|----------------------------------------------------------------------------------------------------------|----------------------------------|
| MC_SetOverride        | Changes the target velocity, the target acceleration, and the target deceleration of the specified axis. | Page 1556 Override Value Setting |

## Parameter Read

| Function block symbol | Processing details         | Reference                |
|-----------------------|----------------------------|--------------------------|
| MC_ReadParameter      | Reads objects of a device. | Page 1561 Parameter Read |

## Parameter Write

| Function block symbol | Processing details          | Reference                 |
|-----------------------|-----------------------------|---------------------------|
| MC_WriteParameter     | Writes objects of a device. | Page 1568 Parameter Write |

## Axis Error Reset

| Function block symbol | Processing details                      | Reference                  |
|-----------------------|-----------------------------------------|----------------------------|
| MC_Reset              | Resets errors and warnings of the axis. | Page 1574 Axis Error Reset |

## Axes Group Error Reset

| Function block symbol | Processing details                                                            | Reference                        |
|-----------------------|-------------------------------------------------------------------------------|----------------------------------|
| MC_GroupReset         | Resets errors and warnings of the axes group and each axis in the axes group. | Page 1577 Axes Group Error Reset |

## Touch Probe Enabled

| Function block symbol | Processing details                                 | Reference                     |
|-----------------------|----------------------------------------------------|-------------------------------|
| MC_TouchProbe         | Records optional data when a trigger event occurs. | Page 1581 Touch Probe Enabled |

## Touch Probe Disabled

| Function block symbol | Processing details                         | Reference                      |
|-----------------------|--------------------------------------------|--------------------------------|
| MC_AbortTrigger       | Disables the latch that is being executed. | Page 1596 Touch Probe Disabled |

## Cam Table Selection

| Function block symbol | Processing details                                                         | Reference                     |
|-----------------------|----------------------------------------------------------------------------|-------------------------------|
| MC_CamTableSelect     | Stores the specified operation profile data (cam data) into the open area. | Page 1602 Cam Table Selection |

## Current Value Change per Cycle

| Function block symbol | Processing details                                                                      | Reference                                |
|-----------------------|-----------------------------------------------------------------------------------------|------------------------------------------|
| MCv_ChangeCycle       | Changes the current value per cycle of the specified operation profile data control FB. | Page 1611 Current Value Change per Cycle |

## All Axes Operation Available

| Function block symbol | Processing details                                     | Reference                              |
|-----------------------|--------------------------------------------------------|----------------------------------------|
| MCv_AllPower          | Switches every axis to the operation available status. | Page 1619 All Axes Operation Available |

## Axes Group Override Value Setting

| Function block symbol | Processing details                                                                                             | Reference                                   |
|-----------------------|----------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| MC_GroupSetOverride   | Changes the target velocity, the target acceleration, and the target deceleration of the specified axes group. | Page 1622 Axes Group Override Value Setting |

## Motion Error Reset

| Function block symbol | Processing details                                   | Reference                    |
|-----------------------|------------------------------------------------------|------------------------------|
| MCv_MotionErrorReset  | Resets all errors and warnings of the Motion system. | Page 1627 Motion Error Reset |

## Control Operation Cycle Synchronization

| Function block symbol   | Processing details                                                             | Reference                                         |
|-------------------------|--------------------------------------------------------------------------------|---------------------------------------------------|
| MCv_SyncOperationCycles | Synchronizes the control operation cycle of the axis with the specified cycle. | Page 1631 Control Operation Cycle Synchronization |

## Advanced Synchronous Control Current Position per Cycle Calculation

| Function block symbol       | Processing details                                                         | Reference                                                                     |
|-----------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| MCv_AdvPositionPerCycleCalc | Calculates the current position per cycle based on the specified cam data. | Page 1634 Advanced Synchronous Control One Cycle Current Position Calculation |

## Advanced Synchronous Control Cam Set Position Calculation

| Function block symbol     | Processing details                                               | Reference                                                              |
|---------------------------|------------------------------------------------------------------|------------------------------------------------------------------------|
| MCv_AdvCamSetPositionCalc | Calculates the cam set position based on the specified cam data. | Page 1637 Cam Set Position Calculation in Advanced Synchronous Control |

## Digital Cam Switch Output

| Function block symbol | Processing details                                          | Reference                           |
|-----------------------|-------------------------------------------------------------|-------------------------------------|
| MC_DigitalCamSwitch   | Outputs the on/off signals according to a given data value. | Page 1640 Digital Cam Switch Output |

## 9.2 Motion Function Blocks

The list of motion related motion control function blocks is shown below.

### OPR

| Function block symbol | Processing details                      | Reference        |
|-----------------------|-----------------------------------------|------------------|
| MC_Home               | Executes homing for the specified axis. | Page 1647 Homing |

### Forced Stop

| Function block symbol | Processing details                        | Reference             |
|-----------------------|-------------------------------------------|-----------------------|
| MC_Stop               | Decelerates the specified axis to a stop. | Page 1658 Forced Stop |

### Group Forced Stop

| Function block symbol | Processing details                              | Reference                   |
|-----------------------|-------------------------------------------------|-----------------------------|
| MC_GroupStop          | Decelerates the specified axes group to a stop. | Page 1663 Group Forced Stop |

### Absolute Value Positioning

| Function block symbol | Processing details                                                          | Reference                            |
|-----------------------|-----------------------------------------------------------------------------|--------------------------------------|
| MC_MoveAbsolute       | Sets the target position of the absolute position and performs positioning. | Page 1669 Absolute Value Positioning |

### Relative Value Positioning

| Function block symbol | Processing details                                                          | Reference                            |
|-----------------------|-----------------------------------------------------------------------------|--------------------------------------|
| MC_MoveRelative       | Sets the movement amount of the relative position and performs positioning. | Page 1682 Relative Value Positioning |

### JOG

| Function block symbol | Processing details                                        | Reference               |
|-----------------------|-----------------------------------------------------------|-------------------------|
| MCv_Jog               | Executes JOG operation according to the command velocity. | Page 1692 JOG Operation |

### Speed Control

| Function block symbol | Processing details                                                                                | Reference               |
|-----------------------|---------------------------------------------------------------------------------------------------|-------------------------|
| MC_MoveVelocity       | Switches the drive unit to csv and performs velocity control according to the specified velocity. | Page 1702 Speed Control |

### Torque Control

| Function block symbol | Processing details                                                                                   | Reference                |
|-----------------------|------------------------------------------------------------------------------------------------------|--------------------------|
| MC_TorqueControl      | Switches the drive unit to cst and performs torque control according to the specified target torque. | Page 1710 Torque Control |

### Speed Control (Including Position Loop)

| Function block symbol | Processing details                                  | Reference                                         |
|-----------------------|-----------------------------------------------------|---------------------------------------------------|
| MCv_SpeedControl      | Performs speed control including the position loop. | Page 1721 Speed Control (Including Position Loop) |

## Absolute Value Linear Interpolation Control

| Function block symbol             | Processing details                                                                                                                     | Reference                                             |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| MCv_MoveLinearInterpolateAbsolute | Specifies the target position of the absolute position of the set axes group and performs positioning by linear interpolation control. | Page 1730 Absolute Value Linear Interpolation Control |

## Relative Value Linear Interpolation Control

| Function block symbol             | Processing details                                                                                                                     | Reference                                             |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| MCv_MoveLinearInterpolateRelative | Specifies the movement amount of the relative position of the set axes group and performs positioning by linear interpolation control. | Page 1745 Relative Value Linear Interpolation Control |

## Absolute Value Circular Interpolation Control

| Function block symbol               | Processing details                                                                                                                                                          | Reference                                               |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| MCv_MoveCircularInterpolateAbsolute | Performs positioning with 2-axis circular interpolation using the configuration axes of the set axes group by setting the end point and sub point of the absolute position. | Page 1759 Absolute Value Circular Interpolation Control |

## Relative Value Circular Interpolation Control

| Function block symbol               | Processing details                                                                                                                                                                                             | Reference                                               |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| MCv_MoveCircularInterpolateRelative | Performs positioning with 2-axis circular interpolation using the configuration axes of the set axes group by setting the relative position from the current position at start to the end point and sub point. | Page 1776 Relative Value Circular Interpolation Control |

## Cam Operation Start

| Function block symbol | Processing details                                        | Reference                     |
|-----------------------|-----------------------------------------------------------|-------------------------------|
| MC_CamIn              | Starts cam operation according to the specified cam data. | Page 1795 Cam Operation Start |

## Gear Operation Start

| Function block symbol | Processing details                                           | Reference                      |
|-----------------------|--------------------------------------------------------------|--------------------------------|
| MC_GearIn             | Starts gear operation according to the specified gear ratio. | Page 1825 Gear Operation Start |

## Addition/Subtraction Positioning

| Function block symbol | Processing details                                                                                                                           | Reference                                  |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| MC_CombineAxes        | Adds or subtracts the movement amounts of the two specified master axes and performs positioning using said value as the commanded position. | Page 1835 Addition/Subtraction Positioning |

## Backlash Compensation Filter

| Function block symbol          | Processing details                                                                                                         | Reference                              |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| MCv_BacklashCompensationFilter | Performs filter processing that compensates the backlash amount in the machine system according to the movement direction. | Page 1847 Backlash Compensation Filter |

## Smoothing Filter

| Function block symbol | Processing details                                               | Reference                  |
|-----------------------|------------------------------------------------------------------|----------------------------|
| MCv_SmoothingFilter   | Performs filter processing according to the specified frequency. | Page 1861 Smoothing Filter |

## Moving Direction Restriction Filter

| Function block symbol | Processing details                                                               | Reference                                     |
|-----------------------|----------------------------------------------------------------------------------|-----------------------------------------------|
| MCv_DirectionFilter   | Performs filter processing to restrict traveling for the set movement direction. | Page 1871 Moving Direction Restriction Filter |

## Speed Limit Filter

| Function block symbol | Processing details                                                             | Reference                    |
|-----------------------|--------------------------------------------------------------------------------|------------------------------|
| MCv_SpeedLimitFilter  | Performs filter processing to restrict to the velocity of the set limit value. | Page 1880 Speed Limit Filter |

## Axis control start wait

| Function block symbol | Processing details                                                                                                                       | Reference                         |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| MCv_MoveWait          | Immediately performs the operation of the multiple-started motion FB for the specified axis by inputting an execution permission signal. | Page 1889 Axis Control Start Wait |

## Axes group control start wait

| Function block symbol | Processing details                                                                                                                             | Reference                               |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| MCv_GroupMoveWait     | Immediately performs the operation of the multiple-started motion FB for the specified axes group by inputting an execution permission signal. | Page 1896 Axes Group Control Start Wait |

## Advanced Synchronous Control

| Function block symbol | Processing details                                                                               | Reference                              |
|-----------------------|--------------------------------------------------------------------------------------------------|----------------------------------------|
| MCv_AdvancedSync      | Starts synchronization control according to the specified advanced synchronous control settings. | Page 1903 Advanced Synchronous Control |

## Multiple Axes Positioning Data Operation

| Function block symbol   | Processing details                                                  | Reference                                          |
|-------------------------|---------------------------------------------------------------------|----------------------------------------------------|
| MCv_MovePositioningData | Operates an axes group according to the specified positioning data. | Page 1909 Multiple Axes Positioning Data Operation |

## Absolute Position Tracking Control

| Function block symbol | Processing details                                                                                                                                                                                                                                                                     | Reference                                    |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| MCv_PositionControl   | Moves the specified axis to the target position according to the limit velocity, acceleration, deceleration, and jerk. In addition, even after the command has reached the target position, the axis can be moved by changing the target position with retrigger or continuous update. | Page 1919 Absolute Position Tracking Control |

## Motion Cyclic Position Control

| Function block symbol | Processing details                                                                      | Reference                                |
|-----------------------|-----------------------------------------------------------------------------------------|------------------------------------------|
| MCv_CyclicPosition    | Sends the target position to the drive unit according to the specified target position. | Page 1932 Motion Cyclic Position Control |

## Motion Cyclic Velocity Control

| Function block symbol | Processing details                                                                      | Reference                                |
|-----------------------|-----------------------------------------------------------------------------------------|------------------------------------------|
| MCv_CyclicVelocity    | Sends the target velocity to the drive unit according to the specified target velocity. | Page 1941 Motion Cyclic Velocity Control |

## Motion Cyclic Torque Control

| Function block symbol | Processing details                                                                    | Reference                              |
|-----------------------|---------------------------------------------------------------------------------------|----------------------------------------|
| MCv_CyclicTorque      | Sends the target torque to the drive unit according to the specified target position. | Page 1946 Motion Cyclic Torque Control |

## 9.3 Standard Function Blocks

The list of motion control function blocks used to perform axis control is shown below.

### Profile Read

| Function block symbol | Processing details                                                       | Reference              |
|-----------------------|--------------------------------------------------------------------------|------------------------|
| MCv_ReadProfileData   | Reads the specified operation profile data from the open area or a file. | Page 1953 Profile Read |

### Profile Write

| Function block symbol | Processing details                                                      | Reference               |
|-----------------------|-------------------------------------------------------------------------|-------------------------|
| MCv_WriteProfileData  | Writes the specified operation profile data to the open area or a file. | Page 1969 Profile Write |



# 10 NETWORK FUNCTION BLOCK LIST

10

How to read the list is shown below.

| Item                  | Description                                      |
|-----------------------|--------------------------------------------------|
| Function block symbol | Indicates a function block name.                 |
| Processing details    | Indicates an overview of the function blocks.    |
| Reference             | Indicates the reference of detailed information. |

## 10.1 Function Blocks for Ethernet

### Opening/disconnecting a connection

| Function block symbol    | Processing details                   | Reference                          |
|--------------------------|--------------------------------------|------------------------------------|
| M+MXF-SQ_ConnectionOpen  | Opens (establishes) a connection.    | Page 1986 M+MXF-SQ_ConnectionOpen  |
| M+MXF-SQ_ConnectionClose | Closes (disconnects) the connection. | Page 1990 M+MXF-SQ_ConnectionClose |

### Function blocks for socket communications

| Function block symbol | Processing details                                                              | Reference                      |
|-----------------------|---------------------------------------------------------------------------------|--------------------------------|
| M+MXF-SQ_Recv_Socket  | Reads the data received from the external device through socket communications. | Page 1992 M+MXF-SQ_Recv_Socket |
| M+MXF-SQ_Send_Socket  | Sends data to the external device through socket communications.                | Page 1996 M+MXF-SQ_Send_Socket |

### Function blocks for SLMP frames

| Function block symbol         | Processing details                                                            | Reference                               |
|-------------------------------|-------------------------------------------------------------------------------|-----------------------------------------|
| M+MXF-SQ_SLMP_DeviceRead_IP   | Reads device data from the SLMP-compatible device specified by an IP address. | Page 1999 M+MXF-SQ_SLMP_DeviceRead_IP   |
| M+MXF-SQ_SLMP_DeviceWrite_IP  | Writes device data to the SLMP-compatible device specified by an IP address.  | Page 2006 M+MXF-SQ_SLMP_DeviceWrite_IP  |
| M+MXF-TSN_SLMP_DeviceRead_IP  | Reads device data from the SLMP-compatible device specified by an IP address. | Page 2013 M+MXF-TSN_SLMP_DeviceRead_IP  |
| M+MXF-TSN_SLMP_DeviceWrite_IP | Writes device data to the SLMP-compatible device specified by an IP address.  | Page 2020 M+MXF-TSN_SLMP_DeviceWrite_IP |

## 10.2 Function Blocks for CC-Link IE TSN

### Remote reset of SLMP frames

| Function block symbol     | Processing details                                                                          | Reference                           |
|---------------------------|---------------------------------------------------------------------------------------------|-------------------------------------|
| M+MXF-TSN_RemoteReset2_IP | Sends the remote RESET of an SLMP request to the target station specified by an IP address. | Page 2027 M+MXF-TSN_RemoteReset2_IP |

## PART 3

# SEQUENCE INSTRUCTIONS/BASIC INSTRUCTIONS

This part consists of the following chapters.

11 SEQUENCE INSTRUCTIONS

---

12 BASIC INSTRUCTIONS

---

# 11 SEQUENCE INSTRUCTIONS

## 11.1 Contact Instructions

### Operation start, series connection, parallel connection

#### LD, LDI, AND, ANI, OR, ORI

- LD: Normally open contact operation start, LDI: Normally closed contact operation start

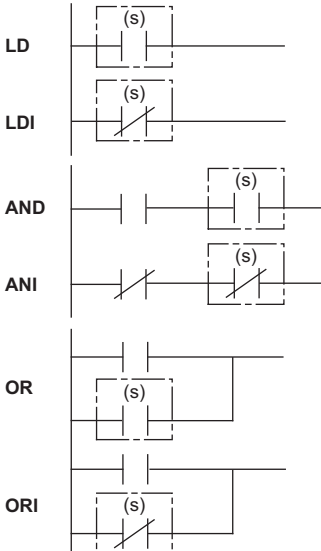
These instructions output the on/off information of the specified device as the operation result.

- AND: Normally open contact series connection, ANI: Normally closed contact series connection

These instructions perform an AND operation between the on/off information of the specified device and the previous operation result, and output the operation result.

- OR: Single normally open contact parallel connection, ORI: Single normally closed contact parallel connection

These instructions perform an OR operation between the on/off information of the specified device and the previous operation result, and output the operation result.

| Ladder                                                                             | ST            |
|------------------------------------------------------------------------------------|---------------|
|  | Not supported |

#### FBD/LD

Not supported

#### ■Execution condition

| Instruction                          | Execution condition |
|--------------------------------------|---------------------|
| LD<br>LDI<br>AND<br>ANI<br>OR<br>ORI | Every scan          |

## Setting data

### ■Description, range, data type

| Operand | Description              | Range | Data type | Data type (label) |
|---------|--------------------------|-------|-----------|-------------------|
| (s)     | Device used as a contact | —     | Bit       | ANY_BOOL          |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (DX) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |             |
| (s)     | ○                                | ○   | ○                                     | ○          | — | ○           | —  | ○                      | —        | — | —  | ○           |

## Processing details

### ■LD, LDI

LD is a normally open contact operation start instruction and LDI is a normally closed contact operation start instruction. These instructions read the on/off information<sup>\*1</sup> of the specified bit device, and output it as the operation result.

<sup>\*1</sup> When a bit of a word device is specified, the instruction outputs on or off according to the status (1 or 0) of the specified bit.

### ■AND, ANI

AND is a normally open contact series connection instruction and ANI is a normally closed contact series connection instruction. These instructions read the on/off information<sup>\*1</sup> of the specified bit device, perform an AND operation with the previous operation result, and output the operation result.

<sup>\*1</sup> When a bit of a word device is specified, the instruction outputs on or off according to the status (1 or 0) of the specified bit.

- Note the following when creating or displaying a program using the engineering tool (in ladder edit mode).
  - Write mode: When the AND and ANI instructions are connected in series, a ladder with up to 24 steps can be created.
  - Read mode: When the AND and ANI instructions are connected in series, a ladder with up to 24 steps can be displayed. If there are more than 24 steps, up to 24 steps are displayed.

### ■OR, ORI

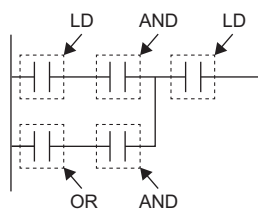
- OR is a single normally open contact parallel connection instruction and ORI is a single normally closed contact parallel connection instruction. These instructions read the on/off information<sup>\*1</sup> of the specified bit device, perform an OR operation with the previous operation result, and output the operation result.

<sup>\*1</sup> When a bit of a word device is specified, the instruction outputs on or off according to the status (1 or 0) of the specified bit.

- Note the following when creating or displaying a program using the engineering tool (in ladder edit mode).
  - Write mode: Up to 23 OR and ORI instructions can be connected consecutively.
  - Read mode: Up to 23 OR and ORI instructions connected consecutively can be displayed. A ladder with more than 23 instructions cannot be displayed correctly.

### ■Operation using LD, LDI, AND, ANI, OR, and ORI combined

An example of operation using LD, AND, and OR combined is shown below. The same operation is performed by using LDI, ANI, and ORI instead.



### Point

Specify a bit in a word device in hexadecimal. (For example, specify "D0.0B" for b11 in D0.)

## Operation error

There is no operation error.

# Pulse operation start, pulse series connection, pulse parallel connection

## LDP, LDF, ANDP, ANDF, ORP, ORF

- LDP: Rising edge pulse operation start

This instruction turns on only at the rising edge (off to on) of the specified bit device.

- LDF: Falling edge pulse operation start

This instruction turns on only at the falling edge (on to off) of the specified bit device.

- ANDP: Rising edge pulse series connection, ANDF: Falling edge pulse series connection

These instructions perform an AND operation with the previous operation result.

- ORP: Rising edge pulse parallel connection, ORF: Falling edge pulse parallel connection

These instructions perform an OR operation with the previous operation result.

| Ladder | ST                                                                                                             |
|--------|----------------------------------------------------------------------------------------------------------------|
|        | <pre> ENO:=LDP(EN,s); ENO:=LDF(EN,s); ENO:=ANDP(EN,s); ENO:=ANDF(EN,s); ENO:=ORP(EN,s); ENO:=ORF(EN,s); </pre> |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction                              | Execution condition |
|------------------------------------------|---------------------|
| LDP<br>LDF<br>ANDP<br>ANDF<br>ORP<br>ORF | Every scan          |

## Setting data

### ■Description, range, data type

| Operand | Description              | Range | Data type | Data type (label) |
|---------|--------------------------|-------|-----------|-------------------|
| (s)     | Device used as a contact | —     | Bit       | ANY_BOOL          |
| EN      | Execution condition      | —     | Bit       | BOOL              |
| ENO     | Execution result         | —     | Bit       | BOOL              |

### ■Applicable devices

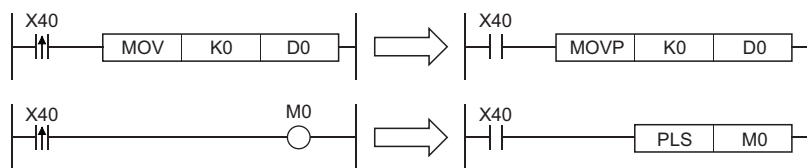
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (DX) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |             |
| (s)     | ○                                | ○   | ○                                     | ○          | — | ○           | —  | ○                      | —        | — | —  | ○           |

## Processing details

### ■LDP, LDF

- LDP is a rising edge pulse operation start instruction, and turns on only at the rising edge (off to on) of the specified bit device. When a bit-specified word device is used, this instruction turns on only when the specified bit changes from 0 to 1. In cases where there is an LDP instruction only, it acts identically to instructions for conversion to pulses that are executed during on (□P).

The following figure shows an example when a ladder using the LDP instruction is replaced with a ladder not using the LDP instruction.



- LDF is a falling edge pulse operation start instruction and turns on only at the falling edge (on to off) of the specified bit device. When a bit-specified word device is used, this instruction turns on only when the specified bit changes from 1 to 0.
- If the LDP instruction is used in the program written in ST language or FBD/LD, ENO turns on at the rising edge (off to on) of the specified bit device (s).
- If the LDF instruction is used in the program written in ST language or FBD/LD, ENO turns on at the falling edge (on to off) of the specified bit device (s).
- If the LDP or LDF instruction is used in the program written in ST language, set EN to be always on.
- If the LDP or LDF instruction is used in the program written in FBD/LD, use a left rail or a variable/constant which is always on for EN.

### ■ANDP, ANDF

- ANDP is a rising edge pulse series connection instruction and ANDF is a falling edge pulse series connection instruction. These instructions perform an AND operation with the previous operation result, and output the operation result. The following table lists the on/off information used by the ANDP and ANDF instructions.

| Device specified by ANDP or ANDF |                           | ANDP status | ANDF status |
|----------------------------------|---------------------------|-------------|-------------|
| Bit device                       | Bit-specified word device |             |             |
| Off→On                           | 0→1                       | On          | Off         |
| Off                              | 0                         | Off         | Off         |
| On                               | 1                         | Off         | Off         |
| On→Off                           | 1→0                       | Off         | On          |

- If the ANDP instruction is used in the program written in ST or FBD/LD language, ENO turns on when the result of AND operation between EN and the rising edge of the specified bit device (s) is on. EN will not be an execution condition.
- If the ANDF instruction is used in the program written in ST or FBD/LD language, ENO turns on when the result of AND operation between EN and the falling edge of the specified bit device (s) is on. EN will not be an execution condition.

## ■ORP, ORF

- ORP is a rising edge pulse parallel connection instruction and ORF is a falling edge pulse parallel connection instruction. These instructions perform an OR operation with the previous operation result, and output the operation result. The following table lists the on/off information used by the ORP and ORF instructions.

| Device specified by ORP or ORF |                           | ORP status | ORF status |
|--------------------------------|---------------------------|------------|------------|
| Bit device                     | Bit-specified word device |            |            |
| Off→On                         | 0→1                       | On         | Off        |
| Off                            | 0                         | Off        | Off        |
| On                             | 1                         | Off        | Off        |
| On→Off                         | 1→0                       | Off        | On         |

- If the ORP instruction is used in the program written in ST or FBD/LD language, ENO turns when the result of OR operation between EN and the rising edge of the specified bit device (s) is on. EN will not be an execution condition.
- If the ORF instruction is used in the program written in ST or FBD/LD language, ENO turns when the result of OR operation between EN and the falling edge of the specified bit device (s) is on. EN will not be an execution condition.

## ■Operation using LDP, LDF, ANDP, ANDF, ORP, and ORF combined

An example of operation using LDP, LDF, ANDP, ANDF, ORP, and ORF combined is same as that using LD, AND, and OR.

( Page 206 LD, LDI, AND, ANI, OR, ORI)

### Operation error

There is no operation error.



# Pulse NOT operation start, pulse NOT series connection, pulse NOT parallel connection

## LDPI, LDFI, ANDPI, ANDFI, ORPI, ORFI

- LDPI: Rising edge pulse NOT operation start

This instruction turns on when the specified device is off, on, or at the falling edge (on to off).

- LDFI: Falling edge pulse NOT operation start

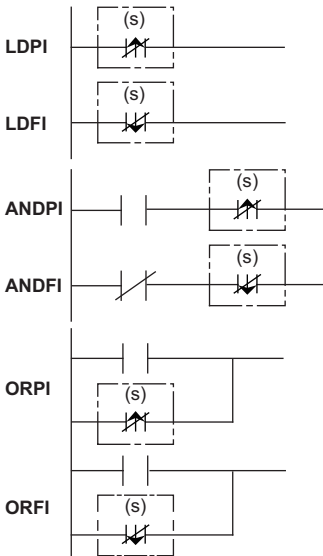
This instruction turns on when the specified bit device is at the rising edge (off to on), off, or on.

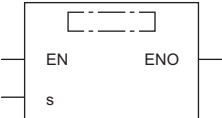
- ANDPI: Rising edge pulse NOT series connection, ANDFI: Falling edge pulse NOT series connection

These instructions perform an AND operation with the previous operation result.

- ORPI: Rising edge pulse NOT parallel connection, ORFI: Falling edge pulse NOT parallel connection

These instructions perform an OR operation with the previous operation result.

| Ladder                                                                             | ST                                                                                                                   |
|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
|  | <pre> ENO:=LDPI(EN,s); ENO:=LDFI(EN,s); ENO:=ANDPI(EN,s); ENO:=ANDFI(EN,s); ENO:=ORPI(EN,s); ENO:=ORFI(EN,s); </pre> |

| FBD/LD                                                                              |
|-------------------------------------------------------------------------------------|
|  |

## ■ Execution condition

| Instruction                                    | Execution condition |
|------------------------------------------------|---------------------|
| LDPI<br>LDFI<br>ANDPI<br>ANDFI<br>ORPI<br>ORFI | Every scan          |

## Setting data

### ■Description, range, data type

| Operand | Description              | Range | Data type | Data type (label) |
|---------|--------------------------|-------|-----------|-------------------|
| (s)     | Device used as a contact | —     | Bit       | ANY_BOOL          |
| EN      | Execution condition      | —     | Bit       | BOOL              |
| ENO     | Execution result         | —     | Bit       | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (DX) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |             |
| (s)     | ○                                | ○   | ○                                     | ○          | — | ○           | —  | ○                      | —        | — | —  | ○           |

## Processing details

### ■LDPI, LDFI

- LDPI is a rising edge pulse NOT operation start instruction, and turns on when the specified device is off, on, or at the falling edge (on to off). When a bit-specified word device is used, this instruction turns on when the specified bit is 0 or 1 or when the bit changes from 1 to 0.
- LDFI is a falling edge pulse NOT operation start instruction, and turns on when the specified bit device is at the rising edge (off to on), off, or on. When a bit-specified word device is used, this instruction turns on when the specified bit is 0 or 1 or when the bit changes from 0 to 1. The following table lists the on/off information used by the LDPI and LDFI instructions.

| Device specified by LDPI or LDFI |                           | LDPI status | LDFI status |
|----------------------------------|---------------------------|-------------|-------------|
| Bit device                       | Bit-specified word device |             |             |
| Off→On                           | 0→1                       | Off         | On          |
| Off                              | 0                         | On          | On          |
| On                               | 1                         | On          | On          |
| On→Off                           | 1→0                       | On          | Off         |

- If the LDPI instruction is used in the program written in ST language or FBD/LD, ENO turns on at the timing except the rising edge (off to on) of the specified bit device (s).
- If the LDFI instruction is used in the program written in ST language or FBD/LD, ENO turns on at the timing except the falling edge (on to off) of the specified bit device (s).
- If the LDPI or LDFI instruction is used in the program written in ST language, set EN to be always on.
- If the LDPI or LDFI instruction is used in the program written in FBD/LD, use a left rail or a variable/constant which is always on for EN.

### ■ANDPI, ANDFI

- ANDPI is a rising edge pulse NOT series connection instruction and ANDFI is a falling edge pulse NOT series connection instruction. These instructions perform an AND operation with the previous operation result, and output the operation result. The following table lists the on/off information used by the ANDPI and ANDFI instructions.

| Device specified by ANDPI or ANDFI |                           | ANDPI status | ANDFI status |
|------------------------------------|---------------------------|--------------|--------------|
| Bit device                         | Bit-specified word device |              |              |
| Off→On                             | 0→1                       | Off          | On           |
| Off                                | 0                         | On           | On           |
| On                                 | 1                         | On           | On           |
| On→Off                             | 1→0                       | On           | Off          |

- If the ANDPI instruction is used in the program written in ST or FBD/LD language, ENO turns on when the result of AND operation between EN and the rising edge of the specified bit device (s) is not on. EN will not be an execution condition.
- If the ANDFI instruction is used in the program written in ST or FBD/LD language, ENO turns on when the result of AND operation between EN and the falling edge of the specified bit device (s) is not on. EN will not be an execution condition.

## ■ORPI, ORFI

- ORPI is a rising edge pulse NOT parallel connection instruction and ORFI is a falling edge pulse NOT parallel connection instruction. These instructions perform an OR operation with the previous operation result, and output the operation result. The following table lists the on/off information used by the ORPI and ORFI instructions.

| Device specified by ORPI or ORFI |                           | ORPI status | ORFI status |
|----------------------------------|---------------------------|-------------|-------------|
| Bit device                       | Bit-specified word device |             |             |
| Off→On                           | 0→1                       | Off         | On          |
| Off                              | 0                         | On          | On          |
| On                               | 1                         | On          | On          |
| On→Off                           | 1→0                       | On          | Off         |

- If the ORPI instruction is used in the program written in ST or FBD/LD language, ENO turns when the result of OR operation between EN and the rising edge of the specified bit device (s) is not on. EN will not be an execution condition.
- If the ORFI instruction is used in the program written in ST or FBD/LD language, ENO turns when the result of OR operation between EN and the falling edge of the specified bit device (s) is not on. EN will not be an execution condition.

## ■Operation using LDPI, LDFI, ANDPI, ANDFI, ORPI, and ORFI combined

An example of operation using LDPI, LDFI, ANDPI, ANDFI, ORPI, and ORFI combined is same as that using LD, AND, and OR. (☞ Page 206 LD, LDI, AND, ANI, OR, ORI)

### Operation error

There is no operation error.

# 11.2 Association Instructions

## Ladder block series/parallel connection

### ANB, ORB

- ANB: Ladder block series connection  
This instruction performs an AND operation between block A and block B.
- ORB: Ladder block parallel connection  
This instruction performs an OR operation between block A and block B.

| Ladder                                                                                                      | ST            |
|-------------------------------------------------------------------------------------------------------------|---------------|
| <div> <div> <div>ANB</div> </div> <div> <div>ORB</div> </div> </div> <div> A: A block<br/>B: B block </div> | Not supported |

### FBD/LD

Not supported

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ANB<br>ORB  | Every scan          |

### Processing details

#### ■ANB

- This instruction performs an AND operation between block A and block B, and outputs the operation result.
- The symbol of the ANB instruction is not a contact but a connection.

#### ■ORB

- This instruction performs an OR operation between block A and block B, and outputs the operation result.
- Ladder blocks, each having two or more contacts, are connected in parallel. Use the OR or ORI instruction for connection of blocks, each having only one contact. The ORB instruction is not required in this case.
- The symbol of the ORB instruction is not a contact but a connection.

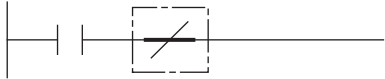
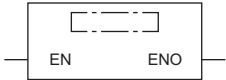
### Operation error

There is no operation error.

# Inverting the operation result

## INV

This instruction inverts the operation result up to just before the INV instruction.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | ENO:=INV(EN); |
| FBD/LD                                                                            |               |
|  |               |

## ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| INV         | Every scan          |

## Processing details

- This instruction inverts the operation result up to just before the INV instruction.

| Operation result up to just before the INV instruction | Operation result after execution of the INV instruction |
|--------------------------------------------------------|---------------------------------------------------------|
| Off                                                    | On                                                      |
| On                                                     | Off                                                     |

## Operation error

There is no operation error.

### Point

- The INV instruction operates based on the results of calculation made until the INV instruction is given. Accordingly, use it in the same position as that of the AND (  Page 206 Operation start, series connection, parallel connection). The INV instruction cannot be used at the LD and OR (  Page 206 Operation start, series connection, parallel connection) positions.
- When a ladder block is used, the operation result is inverted within the range of the ladder block. When the INV instruction and the ANB instruction are used together in the same ladder, pay attention to the inversion range.



Broken line part: Inversion range

For details on the ANB instruction, refer to the following.

 Page 214 ANB, ORB

# Converting the operation result into a pulse

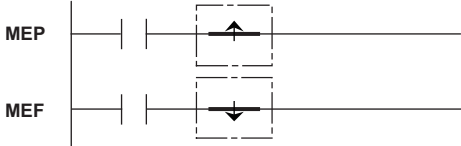
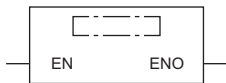
## MEP, MEF

- MEP: Converting the operation result into a pulse (rising edge)

This instruction turns on at the rising edge (off to on) of the operation result up to the MEP instruction.

- MEF: Converting the operation result into a pulse (falling edge)

This instruction turns on at the falling edge (on to off) of the operation result up to the MEF instruction.

| Ladder                                                                            | ST                             |
|-----------------------------------------------------------------------------------|--------------------------------|
|  | ENO:=MEP(EN);<br>ENO:=MEF(EN); |
| FBD/LD                                                                            |                                |
|  |                                |

## ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| MEP<br>MEF  | Every scan          |

## Processing details

### ■MEP

- This instruction turns on (continuity state) at the rising edge (off to on) of the operation result up to the MEP instruction. The instruction turns off (non-continuity state) when the operation result is in another state (not rising edge).
- Use of the MEP instruction eases pulse conversion processing when multiple contacts are connected in series.

### ■MEF

- This instruction turns on (continuity state) at the falling edge (on to off) of the operation result up to the MEF instruction. The instruction turns off (non-continuity state) when the operation result is in another state (not falling edge).
- Use of the MEF instruction eases pulse conversion processing when multiple contacts are connected in series.

## Operation error

There is no operation error.

### Point

- The MEP or MEF instruction may not operate correctly if pulse conversion is performed for an index-modified contact in the subroutine program or in the area between the FOR and NEXT instructions. To perform pulse conversion for an index-modified contact in the subroutine program or in the area between the FOR and NEXT instructions, refer to the following.  
 ➞ Page 217 EGP, EGF
- The MEP or MEF instruction operates based on the result of operation performed from the LD instruction immediately before the MEP or MEF instruction until the MEP or MEF instruction is given. Therefore, use them at the same position as that of the AND (➞ Page 206 Operation start, series connection, parallel connection). The MEP or MEF instruction cannot be used at the LD and OR (➞ Page 206 Operation start, series connection, parallel connection) positions.

# Converting the edge relay operation result into a pulse

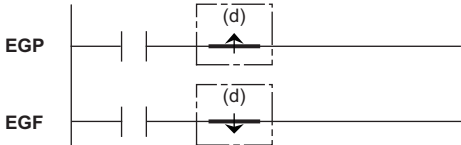
## EGP, EGF

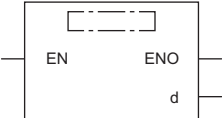
- EGP: Converting the edge relay operation result into a pulse (rising edge)

This instruction stores the operation result up to the EGP instruction in the edge relay (V). The instruction turns on at the rising edge (off to on) of the operation result.

- EGF: Converting the edge relay operation result into a pulse (falling edge)

This instruction stores the operation result up to the EGF instruction in the edge relay (V). The instruction turns on at the falling edge (on to off) of the operation result.

| Ladder                                                                            | ST                                         |
|-----------------------------------------------------------------------------------|--------------------------------------------|
|  | <pre>ENO:=EGP(EN,d); ENO:=EGF(EN,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                                 |
|-------------|-------------------------------------------------------------------------------------|
| EGP         |  |
| EGF         |  |

## Setting data

## Description, range, data type

| Operand | Description                                    | Range | Data type | Data type (label) |
|---------|------------------------------------------------|-------|-----------|-------------------|
| (d)     | Edge relay number for storing operation result | —     | Bit       | ANY_BOOL*1        |
| EN      | Execution condition                            | —     | Bit       | BOOL              |
| ENO     | Execution result                               | —     | Bit       | BOOL              |

\*1 Only bit type labels assigned to the device (V) can be used.

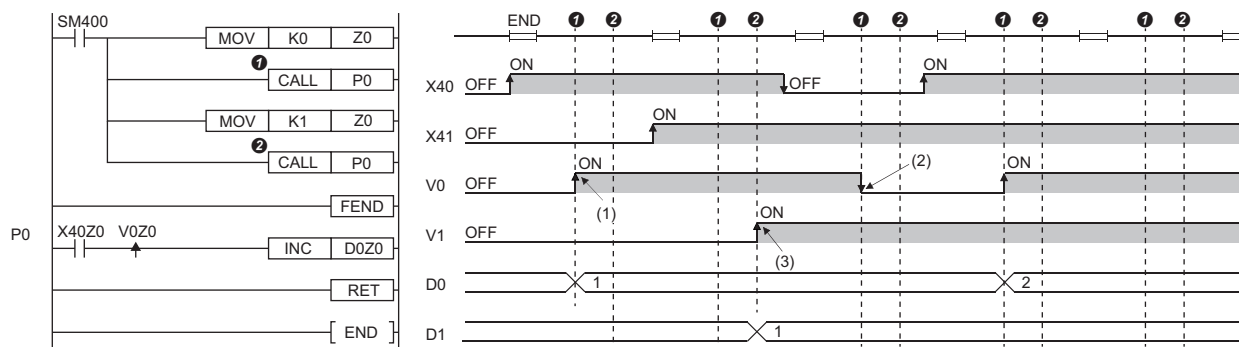
## Applicable devices

| Operand | Bit                              |     | Word                                  |            | Z | Double word |    | Indirect specification | Constant |   |    | Others (V) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (d)     | —                                | —   | —                                     | —          | — | —           | —  | —                      | —        | — | —  | ○          |

## Processing details

### ■EGP

- This instruction stores the operation result up to the EGP instruction in the edge relay (V).
- The instruction turns on (continuity state) at the rising edge (off to on) of the operation result up to the EGP instruction. The instruction turns off (non-continuity state) when the operation result is in another state (staying on, falling edge (on to off), or staying off).
- The instruction is used to perform pulse conversion for index-modified programs in the subroutine program or in the area between the FOR and NEXT instructions.
- The instruction can be used in the same way as the AND instruction.
- The following figure shows the operation performed when the instruction is used in the subroutine program.



- (1) The device turns on at the rising edge of X40.  
 (2) The device turns off at the falling edge of X40.  
 (3) The device turns on at the rising edge of X41.

### ■EGF

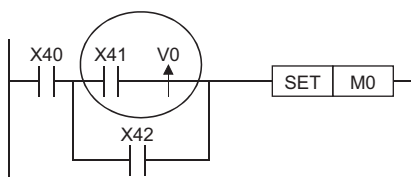
- This instruction stores the operation result up to the EGF instruction in the edge relay (V).
- The instruction turns on (continuity state) at the falling edge (on to off) of the operation result up to the EGF instruction. The instruction turns off (non-continuity state) when the operation result is in another state (staying on, rising edge (off to on), or staying off).
- The instruction is used to perform pulse conversion for index-modified programs in the subroutine program or in the area between the FOR and NEXT instructions.
- The instruction can be used in the same way as the AND instruction.

## Operation error

There is no operation error.

### Point

- The EGP or EGF instruction operates based on the result of operation performed from the LD instruction immediately before the EGP or EGF instruction until the EGP or EGF instruction is given. Therefore, use them at the same position as that of the AND (Page 206 Operation start, series connection, parallel connection). The EGP or EGF instruction cannot be used at the LD and OR (Page 206 Operation start, series connection, parallel connection) positions.
- The instructions cannot be used at the ladder block position shown below.



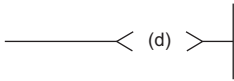


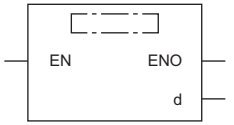
# 11.3 Output Instructions

## Out (excluding the timer, counter, and annunciator)

### OUT

This instruction outputs the operation result to the specified device.

| Ladder                                                                            | ST              |
|-----------------------------------------------------------------------------------|-----------------|
|  | ENO:=OUT(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| OUT         | Every scan          |

### Setting data

### ■Description, range, data type

| Operand | Description                 | Range | Data type | Data type (label) |
|---------|-----------------------------|-------|-----------|-------------------|
| (d)     | On/off target device number | —     | Bit       | ANY_BOOL          |
| EN      | Execution condition         | —     | Bit       | BOOL              |
| ENO     | Execution result            | —     | Bit       | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (DY) |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |             |
| (d)     | ○*1                              | ○   | ○*2                                   | ○           | — | —           | —  | ○                      | —        | — | —  | ○           |

\*1 When F is used, refer to the following.

☞ Page 231 OUT F

\*2 When T or ST is used, refer to the following.

☞ Page 221 OUT T, OUTH T, OUT ST, OUTH ST

When C is used, refer to the following.

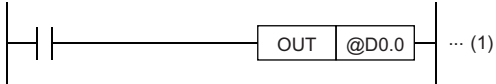
☞ Page 227 OUT C

## Processing details

- This instruction outputs the operation result up to the OUT instruction to the specified device.

| Condition                                | Operation result | Coil/Specified bit |
|------------------------------------------|------------------|--------------------|
| When a bit device is used                | Off              | Off                |
|                                          | On               | On                 |
| When a bit-specified word device is used | Off              | 0                  |
|                                          | On               | 1                  |

- When indirect specification is used, specify the bit as shown below.



(1) The operation result is output to bit 0 of the indirect address stored in D0.

## Operation error

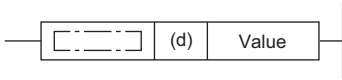
There is no operation error.

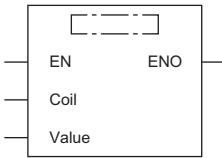
# Timer

## OUT T, OUTH T, OUT ST, OUTH ST

- OUT T: Low-speed timer instruction
- OUTH T: High-speed timer instruction
- OUT ST: Low-speed retentive timer instruction
- OUTH ST: High-speed retentive timer instruction

These instructions start time measurement when the operation result up to the OUT instruction is on. When time is up, the normally open contact turns on (continuity state) and the normally closed contact turns off (non-continuity state).

| Ladder                                                                                                    | ST                                                              |
|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
|  <p>Value: Set value</p> | <pre>ENO:=OUT_T(EN,Coil,Value); ENO:=OUTH(EN,Coil,Value);</pre> |

| FBD/LD                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>Value: Set value<br/>(□ is to be replaced by either of the following: OUT_T, OUTH.)</p> |

### Execution condition

| Instruction                          | Execution condition |
|--------------------------------------|---------------------|
| OUT T<br>OUTH T<br>OUT ST<br>OUTH ST | Every scan          |

### Setting data

### Description, range, data type

| Operand | Description                      | Range      | Data type                | Data type (label) |
|---------|----------------------------------|------------|--------------------------|-------------------|
| (d)     | Timer device or timer type label | —          | Bit                      | ANY_BOOL          |
| Coil    |                                  |            |                          |                   |
| Value   | Value set for the timer          | 0 to 65535 | 16-bit unsigned binary*1 | ANY16*1           |
| EN      | Execution condition              | —          | Bit                      | BOOL              |
| ENO     | Execution result                 | —          | Bit                      | BOOL              |

\*1 If the program is written in ST language or FBD/LD, the data type will be ANY\_INT.

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    |   | Others (DY) |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|---|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |             |
| (d)     | —                                | —   | ○*1                                   | —         | — | —           | —  | —                      | —        | — | —  | — | —           |
| Coil    | —                                | —   | —                                     | —         | — | —           | —  | —                      | —        | — | —  | — | —           |
| Value   | —                                | —   | ○*2                                   | ○         | — | —           | —  | —                      | ○*3      | — | —  | — | —           |

\*1 Only T and ST can be used.

\*2 T, ST, and C cannot be used.

\*3 Only K (decimal constant) can be used.

## Processing details

- These instructions start time measurement, triggered by the coil specified by (d) (in ST language or FBD/LD, displayed as Coil), when the operation result up to the OUT instruction is on. When time is up (current value  $\geq$  set value), the normally open contact turns on (continuity state) and the normally closed contact turns off (non-continuity state).
- When the operation result up to the OUT instruction turns off, the contact responds as shown below.

| Type                       | Timer coil | Current value          | Before time is up     |                         | After time is up      |                         |
|----------------------------|------------|------------------------|-----------------------|-------------------------|-----------------------|-------------------------|
|                            |            |                        | Normally open contact | Normally closed contact | Normally open contact | Normally closed contact |
| Low-speed timer            | Off        | 0                      | Non-continuity        | Continuity              | Non-continuity        | Continuity              |
| High-speed timer           |            |                        |                       |                         |                       |                         |
| Low-speed retentive timer  | Off        | Current value retained | Non-continuity        | Continuity              | Continuity            | Non-continuity          |
| High-speed retentive timer |            |                        |                       |                         |                       |                         |

- To clear the current value of the retentive timer and turn off the contact after time is up, use the RST instruction.
- When the timer set value is 0, the time will be up at execution of the OUT instruction.
- The following operations are performed at execution of the OUT instruction.
  - The coil used as a trigger of the OUT T, OUTH T, OUT ST, or OUTH ST instruction turns on or off.
  - The contact used as a trigger of the OUT T, OUTH T, OUT ST, or OUTH ST instruction turns on or off.
  - The current value of the OUT T, OUTH T, OUT ST, or OUTH ST instruction is changed.
- If the OUT T instruction is skipped by using such as the JMP instruction while the OUT T, OUTH T, OUT ST, or OUTH ST instruction is on, the current value is not updated or the contact is not turned on or off.
- If the same OUT T, OUTH T, OUT ST, or OUTH ST instruction is executed two times or more in a single scan, the current value is updated by the number of times the instruction is executed.

### Point

The timer limit value is set in parameter using the engineering tool.

- Low-speed timer/low-speed retentive timer: 1 to 10000ms (in increments of 1ms) (Default: 100ms)
- High-speed timer/high-speed retentive timer: 0.01 to 100.0ms (in increments of 0.01ms) (Default: 10.0ms)

For the counting method, refer to the following.

 User's manual for the controller used

## Precautions

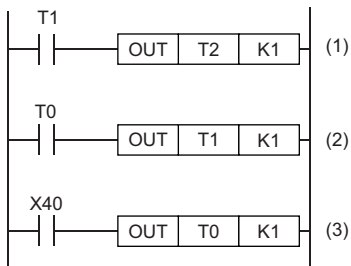
To create a program in which the operation of a timer contact triggers the operation of another timer, program the timers in order from the one that operates last.

When the set value of the timer is shorter than the scan time, if a program is created in order of timer measurements, all timers turn on in the same scan.

- The set value is smaller than the scan time.
- The set value is 1.

### Ex.

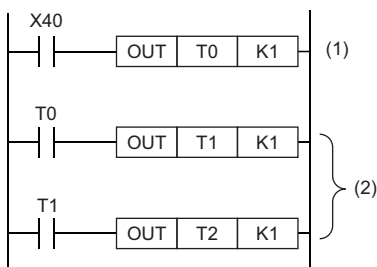
When timers T0 to T2 are programmed in order from the one that measures last



- (3) Timer T0 starts measurement when X40 turns on.
- (2) Timer T1 starts measurement from the next scan after the contact of timer T0 turns on.
- (1) Timer T2 starts measurement from the next scan after the contact of timer T1 turns on.

### Ex.

When timers T0 to T2 are programmed in order of measurement



- (1) Timer T0 starts measurement when X40 turns on.
- (2) When the contact of timer T0 turns on, the contacts of timers T1 and T2 also turn on.

## Operation error

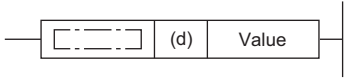
There is no operation error.

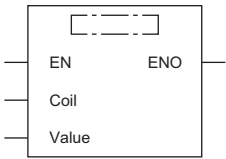
# Long timer

## OUT LT, OUT LST

- OUT LT: Low-speed long timer instruction
- OUT LST: Low-speed long retentive timer instruction

These instructions start time measurement when the operation result up to the OUT instruction is on. When time is up, the normally open contact turns on (continuity state) and the normally closed contact turns off (non-continuity state).

| Ladder                                                                                                    | ST                                    |
|-----------------------------------------------------------------------------------------------------------|---------------------------------------|
|  <p>Value: Set value</p> | <pre>ENO:=OUT_T(EN,Coil,Value);</pre> |

| FBD/LD                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>Value: Set value<br/>(□ is to be replaced by OUT_T.)</p> |

## Execution condition

| Instruction       | Execution condition |
|-------------------|---------------------|
| OUT LT<br>OUT LST | Every scan          |

## Setting data

## Description, range, data type

| Operand | Description                                | Range           | Data type                            | Data type (label)   |
|---------|--------------------------------------------|-----------------|--------------------------------------|---------------------|
| (d)     | Long timer device or long timer type label | —               | Bit                                  | ANY_BOOL            |
| Coil    |                                            |                 |                                      |                     |
| Value   | Value set for the long timer               | 0 to 4294967295 | 32-bit unsigned binary <sup>*1</sup> | ANY32 <sup>*1</sup> |
| EN      | Execution condition                        | —               | Bit                                  | BOOL                |
| ENO     | Execution result                           | —               | Bit                                  | BOOL                |

\*1 If the program is written in ST language or FBD/LD, the data type will be ANY\_INT.

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word     |    | Indirect specification | Constant        |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-----------------|----|------------------------|-----------------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC     | LZ |                        | K, H            | E | \$ |        |
| (d)     | —                                | —   | —                                     | —          | — | ○ <sup>*1</sup> | —  | —                      | —               | — | —  | —      |
| Coil    | —                                | —   | —                                     | —          | — | —               | —  | —                      | —               | — | —  | —      |
| Value   | —                                | —   | ○ <sup>*2</sup>                       | ○          | — | —               | —  | —                      | ○ <sup>*3</sup> | — | —  | —      |

\*1 Only LT and LST can be used.

\*2 T, ST, and C cannot be used.

\*3 Only K (decimal constant) can be used.

## Processing details

- These instructions start time measurement, triggered by the coil specified by (d) (in SD language or FBD/LD, displayed as Coil), when the operation result up to the OUT instruction is on. When time is up (current value  $\geq$  set value), the normally open contact turns on (continuity state) and the normally closed contact turns off (non-continuity state).
- When the operation result up to the OUT instruction turns off, the contact responds as shown below.

| Type                 | Timer coil | Current value          | Before time is up     |                         | After time is up      |                         |
|----------------------|------------|------------------------|-----------------------|-------------------------|-----------------------|-------------------------|
|                      |            |                        | Normally open contact | Normally closed contact | Normally open contact | Normally closed contact |
| Long timer           | Off        | 0                      | Non-continuity        | Continuity              | Non-continuity        | Continuity              |
| Long retentive timer | Off        | Current value retained | Non-continuity        | Continuity              | Continuity            | Non-continuity          |

- To clear the current value of the long retentive timer and turn off the contact after time is up, use the RST instruction.
- When the timer set value is 0, the time will be up at execution of the OUT instruction.
- The following operations are performed at execution of the OUT instruction.
  - The coil used as a trigger of the OUT LT or OUT LST instruction turns on or off.
  - The contact used as a trigger of the OUT LT or OUT LST instruction turns on or off.
  - The current value of the OUT LT or OUT LST instruction is changed.
- If the OUT LT instruction is skipped by using such as the JMP instruction while the OUT LT or OUT LST instruction is on, the current value is not updated or the contact is not turned on or off.
- If the same OUT LT or OUT LST instruction is executed two times or more in a single scan, the current value is updated by the number of times the instruction is executed.

### Point

The timer limit value is set in parameter using the engineering tool.

- Long timer/long retentive timer: 0.001 to 1000ms (in increments of 0.001ms) (Default: 0.001ms)

For the counting method, refer to the following.

 User's manual for the controller used

## Precautions

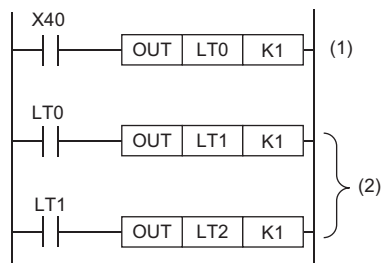
To create a program in which the operation of a long timer contact triggers the operation of another long timer, program the long timers in order from the one that operates first.

When long timers are programmed in order from the one that operates last, the timer measurement error may increase.

When the setting value of the long timer is shorter than the scan time, the operations are as follows.

**Ex.**

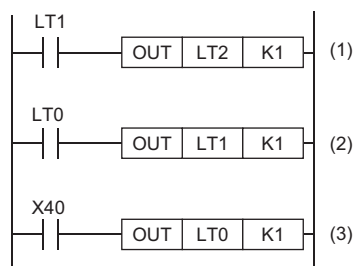
When long timers LT0 to LT2 are programmed in order of measurement



- (1) Timer LT0 starts measurement when X40 turns on.
- (2) When the contact of timer LT0 turns on, timer LT1 and then timer LT2 start measurement.

**Ex.**

When timers LT0 to LT2 are programmed in order from the one that measures last



- (3) Timer LT0 starts measurement when X40 turns on.
- (2) Long timer LT1 starts measurement from the next scan after the contact of long timer LT0 turns on.
- (1) Long timer LT2 starts measurement from the next scan after the contact of long timer LT1 turns on.

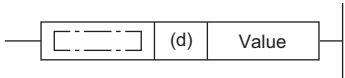
## Operation error

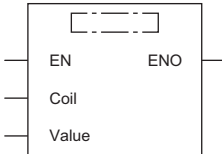
There is no operation error.



## OUT C

This instruction increments the current counter value (count value) by one when the operation result up to the OUT instruction turns on. When the count value reaches the set value, the normally open contact of the counter turns on (continuity state) and the normally closed contact turns off (non-continuity state).

| Ladder                                                                                                    | ST                                    |
|-----------------------------------------------------------------------------------------------------------|---------------------------------------|
|  <p>Value: Set value</p> | <pre>ENO:=OUT_C(EN,Coil,Value);</pre> |

| FBD/LD                                                                                                    |
|-----------------------------------------------------------------------------------------------------------|
|  <p>Value: Set value</p> |

## ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| OUT C       | Every scan          |

## Setting data

## ■Description, range, data type

| Operand | Description               | Range      | Data type                            | Data type (label)      |
|---------|---------------------------|------------|--------------------------------------|------------------------|
| (d)     | Counter number            | —          | Bit                                  | ANY_BOOL <sup>*1</sup> |
| Coil    |                           |            |                                      |                        |
| Value   | Value set for the counter | 0 to 65535 | 16-bit unsigned binary <sup>*2</sup> | ANY16 <sup>*2</sup>    |
| EN      | Execution condition       | —          | Bit                                  | BOOL                   |
| ENO     | Execution result          | —          | Bit                                  | BOOL                   |

\*1 Only counter type labels can be used.

\*2 If the program is written in ST language or FBD/LD, the data type will be ANY\_INT.

## ■Applicable devices

| Operand | Bit                              |      | Word                                  |             | Z | Double word |    | Indirect specification | Constant        |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|-----------------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ |   | LT, LST, LC | LZ |                        | K, H            | E | \$ |        |
| (d)     | —                                | —    | ○ <sup>*1</sup>                       | —           | — | —           | —  | —                      | —               | — | —  | —      |
| Coil    | —                                | —    | ○ <sup>*1</sup>                       | —           | — | —           | —  | —                      | —               | — | —  | —      |
| Value   | —                                | —    | ○ <sup>*2</sup>                       | ○           | — | —           | —  | —                      | ○ <sup>*3</sup> | — | —  | —      |

\*1 Only C can be used.

\*2 T, ST, and C cannot be used.

\*3 Only K (decimal constant) can be used.

## Processing details

- This instruction increments the current counter value (count value) in the device specified by (d) (in ST language or FBD/LD, displayed as Coil) by one on the rising edge (off to on) of the operation result up to the OUT instruction. When the count value reaches the set value (current value  $\geq$  set value), the normally open contact turns on (continuity state) and the normally closed contact turns off (non-continuity state).
- When the set value is 0, the same processing is performed as when it is set to the above.
- Counting is disabled while the operation result remains on. (Count input does not need to be converted into pulses.)
- After counting-up, the count value and contact status remain unchanged until the RST instruction is executed.

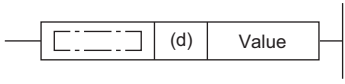
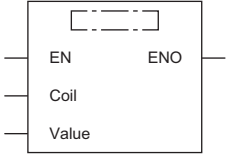
## Operation error

There is no operation error.

# Long counter

## OUT LC

This instruction increments the current long counter value (count value) by one on the rising edge (off to on) of the operation result up to the OUT instruction. When the count value reaches the set value, the normally open contact of the long counter turns on (continuity state) and the normally closed contact turns off (non-continuity state).

| Ladder                                                                                                                                        | ST                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
|  <p>Value: Set value</p>                                     | <pre>ENO:=OUT_C(EN,Coil,Value);</pre> |
| FBD/LD                                                                                                                                        |                                       |
|  <p>Value: Set value<br/>(□ is to be replaced by OUT_C.)</p> |                                       |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| OUT LC      | Every scan          |

### Setting data

### Description, range, data type

| Operand | Description                    | Range           | Data type                            | Data type (label)      |
|---------|--------------------------------|-----------------|--------------------------------------|------------------------|
| (d)     | Long counter number            | —               | Bit                                  | ANY_BOOL <sup>*1</sup> |
| Coil    |                                |                 |                                      |                        |
| Value   | Set value for the long counter | 0 to 4294967295 | 32-bit unsigned binary <sup>*2</sup> | ANY32 <sup>*2</sup>    |
| EN      | Execution condition            | —               | Bit                                  | BOOL                   |
| ENO     | Execution result               | —               | Bit                                  | BOOL                   |

\*1 Only long counter type labels can be used.

\*2 If the program is written in ST language or FBD/LD, the data type will be ANY\_INT.

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word     |    | Indirect specification | Constant        |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-----------------|----|------------------------|-----------------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC     | LZ |                        | K, H            | E | \$ |        |
| (d)     | —                                | —    | —                                     | —           | — | ○ <sup>*1</sup> | —  | —                      | —               | — | —  | —      |
| Coil    |                                  |      |                                       |             |   |                 |    |                        |                 |   |    |        |
| Value   | —                                | —    | ○ <sup>*2</sup>                       | ○           | — | —               | —  | —                      | ○ <sup>*3</sup> | — | —  | —      |

\*1 Only LC can be used.

\*2 T, ST, and C cannot be used.

\*3 Only K (decimal constant) can be used.

## Processing details

- This instruction increments the current long counter value (count value) in the device specified by (d) (in ST language or FBD/LD, displayed as Coil) by one on the rising edge (off to on) of the operation result up to the OUT instruction. When the count value reaches the set value (current value  $\geq$  set value), the normally open contact turns on (continuity state) and the normally closed contact turns off (non-continuity state).
- When the set value is 0, the same processing is performed as when it is set to the above.
- Counting is disabled while the operation result remains on. (Count input does not need to be converted into pulses.)
- After counting-up, the count value and contact status remain unchanged until the RST instruction is executed.

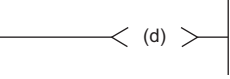
## Operation error

There is no operation error.

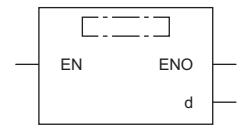
# Annunciator

## OUT F

This instruction outputs the operation result up to the OUT F instruction to the specified annunciator.

| Ladder                                                                            | ST              |
|-----------------------------------------------------------------------------------|-----------------|
|  | ENO:=OUT(EN,d); |

## FBD/LD



(□ is to be replaced by OUT.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| OUT F       | Every scan          |

## Setting data

## Description, range, data type

| Operand | Description               | Range | Data type | Data type (label)      |
|---------|---------------------------|-------|-----------|------------------------|
| (d)     | Target annunciator number | —     | Bit       | ANY_BOOL <sup>*1</sup> |
| EN      | Execution condition       | —     | Bit       | BOOL                   |
| ENO     | Execution result          | —     | Bit       | BOOL                   |

<sup>\*1</sup> Only labels assigned to the annunciator can be used.

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○ <sup>*1</sup>                  | —    | —                                     | —           | — | —           | —  | —                      | —        | — | —  | —      |

<sup>\*1</sup> Only F can be used.

## Processing details

- This instruction outputs the operation result up to the OUT F instruction to the specified annunciator.
- When the annunciator (F) is turned on by this instruction, the following are performed.
  - The USER LED of the controller turns on.
  - The annunciator number (F number) to be turned on is stored in the special register (SD64 to SD79).
  - The value in SD63 is incremented by one.
- If the value in SD63 is 16 (meaning 16 annunciators are already on), the annunciator number will not be stored in the special register (SD64 to SD79) even when a new annunciator turns on.
- When the annunciator (F) is turned off by this instruction, the following are performed.
  - The coil turns off, but the USER LED status and the data in SD63 to SD79 remain unchanged.
  - To turn off the USER LED or delete the annunciator number that has been turned off by this instruction from SD63 to SD79, use the RST F instruction.

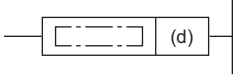
## Operation error

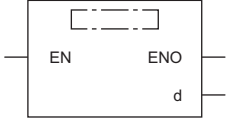
There is no operation error.

## Setting devices (excluding annunciator)

### SET

This instruction turns on the specified bit.

| Ladder                                                                            | ST              |
|-----------------------------------------------------------------------------------|-----------------|
|  | ENO:=SET(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### ■Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| SET         |  |

### Setting data

### ■Description, range, data type

| Operand | Description                                                      | Range | Data type | Data type (label) |
|---------|------------------------------------------------------------------|-------|-----------|-------------------|
| (d)     | Set target bit device number or bit specification of word device | —     | Bit       | ANY_BOOL          |
| EN      | Execution condition                                              | —     | Bit       | BOOL              |
| ENO     | Execution result                                                 | —     | Bit       | BOOL              |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (DY) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |             |
| (d)     | ○*1                              | ○    | —                                     | —           | — | —           | —  | ○                      | —        | — | —  | ○           |

\*1 When F is used, refer to the following.

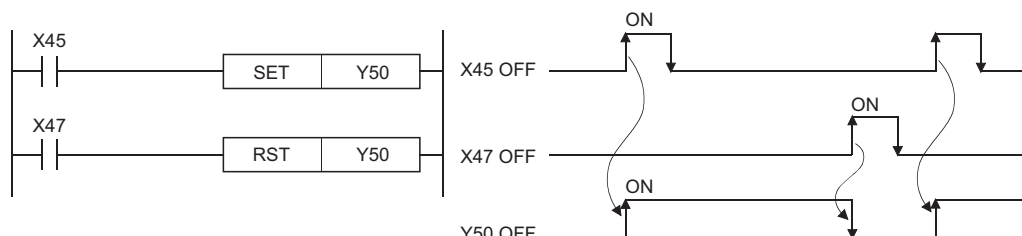
 Page 236 SET F

## Processing details

- This instruction changes the device status as follows when the execution command turns on.

| Device                    | Status                        |
|---------------------------|-------------------------------|
| Bit device                | Turns on the coil or contact. |
| Bit-specified word device | Sets the specified bit to 1.  |

- The device that has been turned on remains on even after the execution command turns off. The device that has been turned on can be turned off by using the RST instruction.



- When the execution command is off, the device status does not change.

## Operation error

There is no operation error.

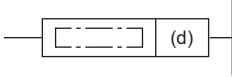
### Point

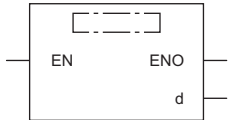
When X is used, specify a device number that is not used in actual input. If the number that is used in actual input is specified, the data of actual input is written over the input device (X) specified by the SET instruction.

## Resetting devices (excluding annunciator)

### RST

This instruction turns off the specified device. For the timer and counter, the instruction clears the current value to 0 and turns off the contact or coil.

| Ladder                                                                            | ST              |
|-----------------------------------------------------------------------------------|-----------------|
|  | ENO:=RST(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| RST         |  |

### Setting data

### Description, range, data type

| Operand | Description                                                                                          | Range | Data type            | Data type (label) |
|---------|------------------------------------------------------------------------------------------------------|-------|----------------------|-------------------|
| (d)     | Reset target bit device number, bit specification of word device, or reset target word device number | —     | Bit/Word/Double word | ANY_ELEMENTARY    |
| EN      | Execution condition                                                                                  | —     | Bit                  | BOOL              |
| ENO     | Execution result                                                                                     | —     | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   |             | Double word |      | Indirect specification | Constant |    |   | Others (DY) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|-------------|------|------------------------|----------|----|---|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |             |
| (d)     | ○*1                              | ○   | ○                                     | ○          | ○ | ○           | ○           | ○    | ○                      | —        | —  | — | ○           |

\*1 When F is used, refer to the following.

Page 238 RST F

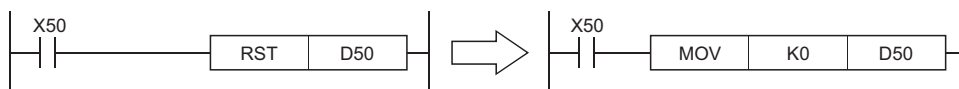


## Processing details

- This instruction changes the device status as follows when the execution command turns on.

| Device                                   | Status                                                           |
|------------------------------------------|------------------------------------------------------------------|
| Bit device                               | Turns off the coil or contact.                                   |
| Timer, counter                           | Clears the current value to 0 and turns off the coil or contact. |
| Bit-specified word device                | Sets the specified bit to 0.                                     |
| Word device other than timer and counter | Clears the data to 0.                                            |

- When the execution command is off, the device status does not change.
- The RST instruction specifying a word device operates in the same way as the following ladder.



## Operation error

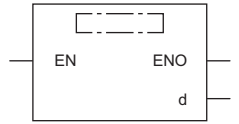
There is no operation error.

# Setting annunciator

## SET F

This instruction turns on the specified annunciator.

| Ladder                                                                            | ST              |
|-----------------------------------------------------------------------------------|-----------------|
|  | ENO:=SET(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |
| (□ is to be replaced by SET.)                                                     |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| SET F       |  |

### Setting data

### Description, range, data type

| Operand | Description                              | Range | Data type | Data type (label) |
|---------|------------------------------------------|-------|-----------|-------------------|
| (d)     | Set target annunciator number (F number) | —     | Bit       | ANY_BOOL          |
| EN      | Execution condition                      | —     | Bit       | BOOL              |
| ENO     | Execution result                         | —     | Bit       | BOOL              |

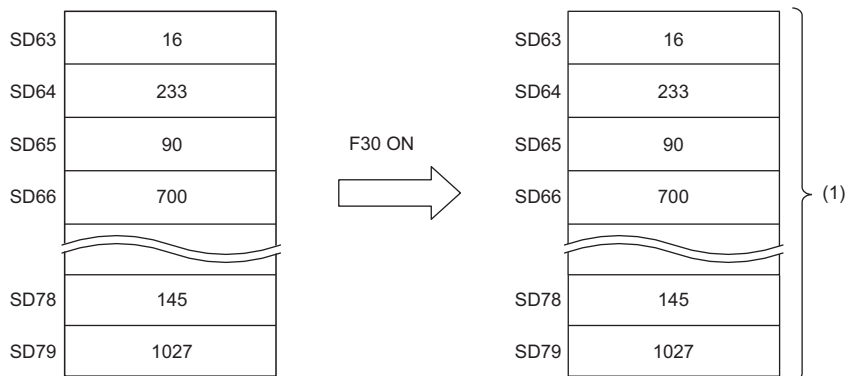
### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○*1                              | —    | —                                     | —           | — | —           | —  | —                      | —        | — | —  | —      |

\*1 Only F can be used.

## Processing details

- This instruction turns on the annunciator specified by (d) when the execution command turns on.
- When the annunciator (F) is turned on, the following are performed.
  - The USER LED turns on.
  - The annunciator number (F number) turned on is stored in the special register (SD64 to SD79).
  - The value in SD63 is incremented by one.
- If the value in SD63 is 16 (meaning 16 annunciators are already on), the annunciator number will not be stored in the special register (SD64 to SD79) even when a new annunciator turns on.



(1) The data remain the same.

## Operation error

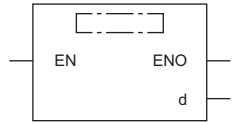
There is no operation error.

# Resetting annunciator

## RST F

This instruction turns off the specified annunciator.

| Ladder                                                                            | ST              |
|-----------------------------------------------------------------------------------|-----------------|
|  | ENO:=RST(EN,d); |

| FBD/LD                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------|
| <br>(□ is to be replaced by RST.) |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| RST F       |  |

### Setting data

### Description, range, data type

| Operand | Description                                | Range | Data type         | Data type (label)      |
|---------|--------------------------------------------|-------|-------------------|------------------------|
| (d)     | Reset target annunciator number (F number) | —     | Bit <sup>*1</sup> | ANY_BOOL <sup>*1</sup> |
| EN      | Execution condition                        | —     | Bit               | BOOL                   |
| ENO     | Execution result                           | —     | Bit               | BOOL                   |

<sup>\*1</sup> If the program is written in ST language or FBD/LD, the data type will be ANY\_ELEMENTARY.

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○ <sup>*1</sup>                  | —    | —                                     | —           | — | —           | —  | —                      | —        | — | —  | —      |

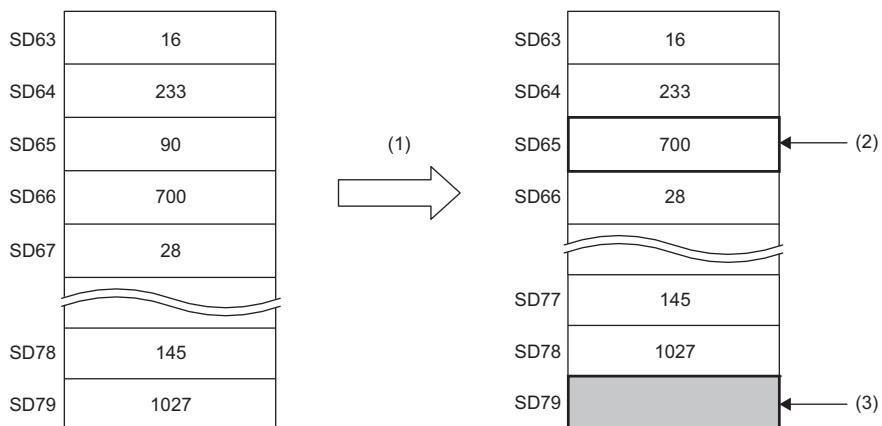
<sup>\*1</sup> Only F can be used.

## Processing details

- This instruction turns off the annunciator specified by (d) when the execution command turns on.
- The annunciator number (F number) turned off is deleted from the special register (SD64 to SD79), and the value in SD63 is decremented by one.
- If the value in SD63 is 16, the corresponding annunciator number is deleted from SD64 to SD79 by the RST instruction. If an annunciator with a number not registered in SD64 to SD79 has been turned on, the number is newly registered. If all annunciator numbers in SD64 to SD79 are reset (turned off), the USER LED of the controller turns off.

### Ex.

When the value in SD63 is 16 and there is an annunciator number that is not registered



(1) Reset F90.

(2) The F number in SD66 is shifted to this area.

(3) New F number is stored.

## Operation error

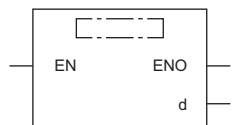
There is no operation error.

# Rising edge output

## PLS

This instruction turns on the specified device for one scan on the rising edge (off to on) of the execution command.

| Ladder                                                                            | ST              |
|-----------------------------------------------------------------------------------|-----------------|
|  | ENO:=PLS(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| PLS         |  |

### Setting data

### Description, range, data type

| Operand | Description                           | Range | Data type | Data type (label) |
|---------|---------------------------------------|-------|-----------|-------------------|
| (d)     | Pulse conversion target device number | —     | Bit       | ANY_BOOL          |
| EN      | Execution condition                   | —     | Bit       | BOOL              |
| ENO     | Execution result                      | —     | Bit       | BOOL              |

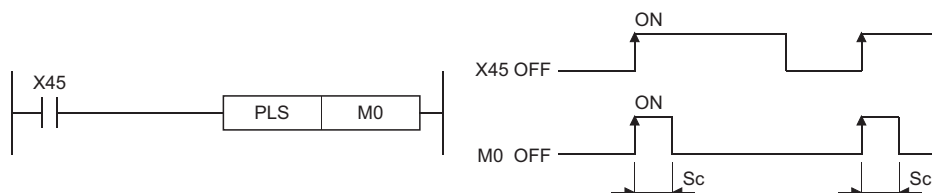
### Applicable devices

| Operand | Bit                              |     | Word                                  |             | Z | Double word |    | Indirect specification | Constant |   |    | Others (DY) |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |             |
| (d)     | ○                                | ○   | ○                                     | ○           | — | —           | —  | ○                      | —        | — | —  | ○           |

## Processing details

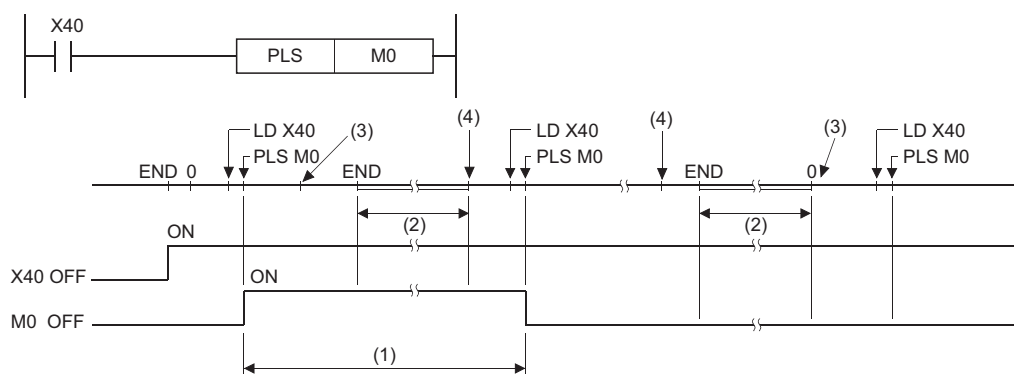
- This instruction turns on the specified device on the rising edge (off to on) of the execution command. When the execution command is in another state (staying on, falling edge (on to off), or staying off), the instruction turns off the specified device. If only one PLS instruction in the device specified by (d) is executed in a single scan, the specified device turns on for one scan. For the operation to be performed if more than one PLS instruction is executed during one scan, refer to the following.

Page 53 Operations arising when the OUT, SET/RST, and PLS/PLF instructions of the same device are used



Sc: 1 scan

- Once after execution of the PLS instruction, even if the switch of the controller is moved to the STOP position and then the RUN position again, the PLS instruction is not executed.



(1) M0 turns on for one scan.

(2) Controller operation stop time

(3) Change the RUN/STOP/RESET switch of the controller from RUN→STOP.

(4) Change the RUN/STOP/RESET switch of the controller from STOP→RUN.

- If the latch relay (L) is specified as the execution command and the system is powered on while the latch relay is on, the execution command turns on in the first scan, triggering execution of the PLS instruction and turning on the specified device. The device that has been turned on in the first scan after power-on can be turned off by the next PLS instruction.
- The PLS instruction performs OFF processing at the execution of the next instruction after the instruction execution.

### Point

- Note that if the PLS instruction is jumped by using the CJ instruction or the executed subroutine program is not called by using the CALL(P) instruction, the device specified by (d) may be on for more than one scan.

## Operation error

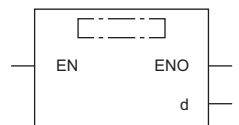
There is no operation error.

# Falling edge output

## PLF

This instruction turns on the specified device for one scan on the falling edge (on to off) of the execution command.

| Ladder                                                                            | ST              |
|-----------------------------------------------------------------------------------|-----------------|
|  | ENO:=PLF(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| PLF         |  |

### Setting data

### Description, range, data type

| Operand | Description                           | Range | Data type | Data type (label) |
|---------|---------------------------------------|-------|-----------|-------------------|
| (d)     | Pulse conversion target device number | —     | Bit       | ANY_BOOL          |
| EN      | Execution condition                   | —     | Bit       | BOOL              |
| ENO     | Execution result                      | —     | Bit       | BOOL              |

### Applicable devices

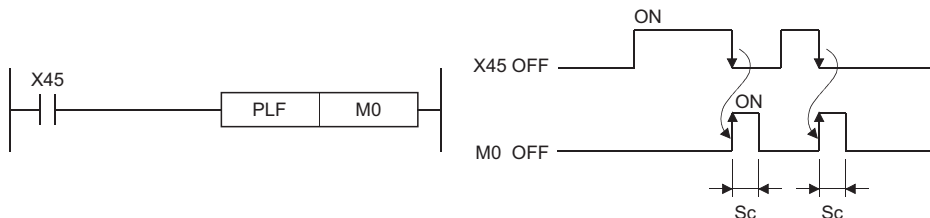
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (DY) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |             |
| (d)     | ○                                | ○    | ○                                     | ○           | — | —           | —  | ○                      | —        | — | —  | ○           |



## Processing details

- This instruction turns on the specified device on the falling edge (on to off) of the execution command. When the execution command is in another state (staying off, rising edge (off to on), or staying on), the instruction turns off the specified device. If only one PLF instruction in the device specified by (d) is executed during one scan, the specified device turns on for one scan. For the operation to be performed if more than one PLF instruction is executed during one scan, refer to the following.

☞ Page 53 Operations arising when the OUT, SET/RST, and PLS/PLF instructions of the same device are used



Sc: 1 scan

- Once after execution of the PLF instruction, even if the switch of the controller is moved to the STOP position and then the RUN position again, the PLF instruction is not executed.
- The PLF instruction performs OFF processing at the execution of the next instruction after the instruction execution.

### Point

Note that if the PLF instruction is jumped by using the CJ instruction or the executed subroutine program is not called by using the CALL(P) instruction, the device specified by (d) may be on for more than one scan.

## Operation error

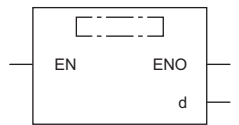
There is no operation error.

# Inverting the bit device output

## FF

This instruction inverts the status of the specified device.

| Ladder                                                                            | ST             |
|-----------------------------------------------------------------------------------|----------------|
|  | ENO:=FF(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| FF          |  |

### Setting data

### Description, range, data type

| Operand | Description                    | Range | Data type | Data type (label) |
|---------|--------------------------------|-------|-----------|-------------------|
| (d)     | Inversion target device number | —     | Bit       | ANY_BOOL          |
| EN      | Execution condition            | —     | Bit       | BOOL              |
| ENO     | Execution result               | —     | Bit       | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others (DY) |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |             |
| (d)     | ○                                | ○   | ○                                     | ○         | — | —           | —  | ○                      | —        | — | —  | ○           |

### Processing details

- This instruction inverts the status of the device specified by (d) on the rising edge of the execution command.

| Device                    | Device status                          |                                       |
|---------------------------|----------------------------------------|---------------------------------------|
|                           | Before execution of the FF instruction | After execution of the FF instruction |
| Bit device                | Off                                    | On                                    |
|                           | On                                     | Off                                   |
| Bit-specified word device | 0                                      | 1                                     |
|                           | 1                                      | 0                                     |

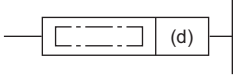
### Operation error

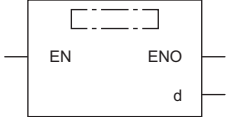
There is no operation error.

# Converting the direct access output into a pulse

## DELTA(P)

These instructions convert the specified direct access output (DY) into pulse output.

| Ladder                                                                            | ST                                              |
|-----------------------------------------------------------------------------------|-------------------------------------------------|
|  | <pre>ENO:=DELTA(EN,d); ENO:=DELTAP(EN,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### ■Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DELTA       |  |
| DELTAP      |  |

### Setting data

### ■Description, range, data type

| Operand | Description                           | Range | Data type | Data type (label)      |
|---------|---------------------------------------|-------|-----------|------------------------|
| (d)     | Pulse conversion target device number | —     | Bit       | ANY_BOOL <sup>*1</sup> |
| EN      | Execution condition                   | —     | Bit       | BOOL                   |
| ENO     | Execution result                      | —     | Bit       | BOOL                   |

\*1 Only labels assigned to the device (DY) can be used.

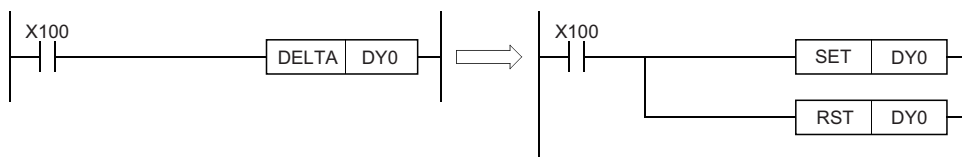
### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            | Double word |             | Indirect specification | Constant |   |    | Others (DY) |
|---------|----------------------------------|-----|---------------------------------------|------------|-------------|-------------|------------------------|----------|---|----|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |             |
| (d)     | —                                | —   | —                                     | —          | —           | —           | —                      | —        | — | —  | ○           |

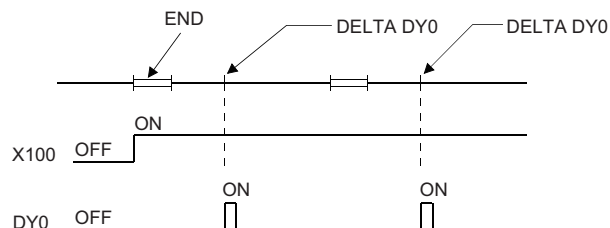
## Processing details

- These instructions convert the direct access output (DY) specified by (d) into pulse output. If DY0 is specified by (d), the program operates in the same way as the one that uses the SET and RST instructions.

The following figure shows an example when a ladder using the DELTA instruction is replaced with a ladder using the SET/RST instructions.



The following figure shows the operation of the instruction.



## Precautions

The DELTA(P) instruction is used as an execution command (rising edge execution) for intelligent function modules. The instruction cannot be used as an actual output command for output modules.

## Operation error

There is no operation error.

### Point

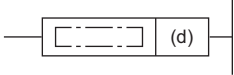
The DELTA(P) instruction is used to set a preset value of the high-speed counter module.

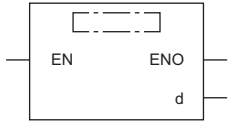
# 11.4 Shift Instructions

## Shifting bit devices

### SFT(P)

These instructions shift the on/off state of the device area just before the one specified to the specified device area, and turn off the shift source device.

| Ladder                                                                            | ST                                          |
|-----------------------------------------------------------------------------------|---------------------------------------------|
|  | <pre>ENO:=SFT(EN,d); ENO:=SFTP(EN,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### ■Execution condition

| Instruction | Execution condition                                                                 |
|-------------|-------------------------------------------------------------------------------------|
| SFT         |    |
| SFTP        |  |

### Setting data

### ■Description, range, data type

| Operand | Description         | Range | Data type | Data type (label) |
|---------|---------------------|-------|-----------|-------------------|
| (d)     | Shift target device | —     | Bit       | ANY_BOOL          |
| EN      | Execution condition | —     | Bit       | BOOL              |
| ENO     | Execution result    | —     | Bit       | BOOL              |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (DY) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|-------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |             |
| (d)     | ○                                | ○    | ○                                     | ○           | — | —           | —  | ○                      | —        | — | —  | ○           |

## Processing details

### ■Bit device

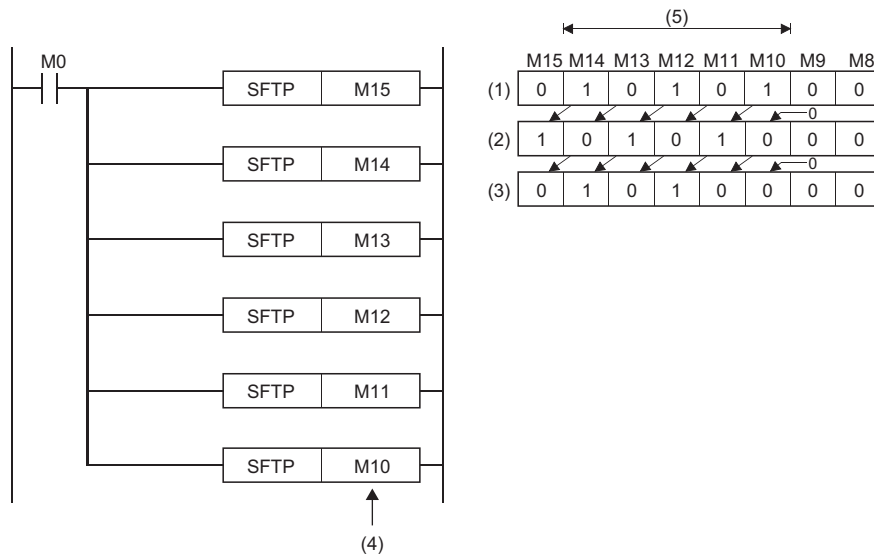
These instructions shift the on/off state of the device area just before the one specified by (d) to the device area specified by (d). After the data is shifted, the data of the shift source device area is turned off.

#### Point

When the SFTP(P) instruction is used consecutively, program devices in descending order of the device numbers.

#### Ex.

The following figure shows an example when the SFTP instruction shifts the device from M10 to M11.



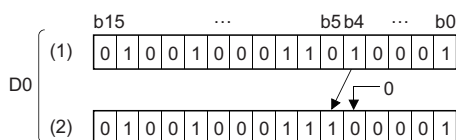
- (1) Initial state
- (2) After the 1st shift input
- (3) After the 2nd shift input
- (5) Shift range

### ■Bit-specified word device

These instructions shift the 1/0 state of the bit just before the one specified by (d) to the bit specified by (d). After the data is shifted, the data of the shift source bit is set to 0.

#### Ex.

The SFTP(P) instruction that specifies D0.5 (b5 in D0) is executed, it shifts the 1/0 state of b4 in D0 to b5, and sets b4 to 0.



- (1) Before shifting the bit
- (2) After shifting the bit

## Operation error

There is no operation error.

# 11.5 Master Control Instructions

11

## Setting/resetting a master control

### MC, MCR

- MC: This instruction starts a master control.
- MCR: This instruction ends a master control.

| Ladder                           | ST                                          |
|----------------------------------|---------------------------------------------|
| <p>(1) Master control ladder</p> | <pre>ENO:=MC(EN,N,d); ENO:=MCR(EN,N);</pre> |

| FBD/LD    |            |
|-----------|------------|
| <p>MC</p> | <p>MCR</p> |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| MC<br>MCR   | Every scan          |

### Setting data

### Description, range, data type

| Operand | Description                          | Range     | Data type   | Data type (label)     |
|---------|--------------------------------------|-----------|-------------|-----------------------|
| (N)     | Nesting                              | N0 to N14 | Device name | ANY16_S <sup>*1</sup> |
| (d)     | Number of the device to be turned on | —         | Bit         | ANY_BOOL              |
| EN      | Execution condition                  | —         | Bit         | BOOL                  |
| ENO     | Execution result                     | —         | Bit         | BOOL                  |

\*1 Only labels assigned to the device (N) or to which constants are assigned can be used.

### Applicable devices

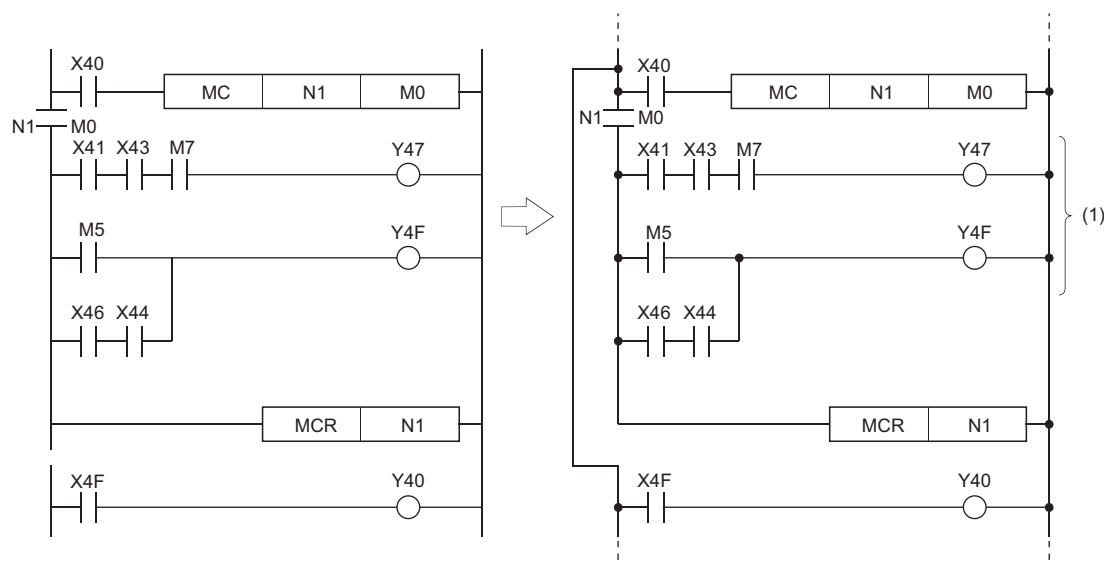
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |    |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|----|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ | N      | DY |
| (N)     | —                                | —   | —                                     | —          | — | —           | —  | —                      | —        | — | —  | ○      | —  |
| (d)     | ○                                | ○   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      | ○  |

## Processing details

These instructions are used to create an efficient ladder switching program by opening and closing the common rails of the ladder.

The following is the program example using the master control instructions.

(Left: Display on the engineering tool, Right: Actual operation)



(1) Executed only when X40 is on.

### MC

- If the execution command of the MC instruction is on when a master control starts, the operation result between the MC and MCR instructions will be the one as programmed. If the execution command is off, the operation result between the MC and MCR instructions will be as follows.

| Device                                                                                                                                                 | Status                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| High-speed timer<br>Low-speed timer                                                                                                                    | The count value is set to 0, and both the coil and contact are turned off.                |
| High-speed retentive timer<br>Low-speed retentive timer<br>Counter                                                                                     | The coil is turned off, but both the count value and contact maintain the current status. |
| Device used by the OUT instruction                                                                                                                     | Forcibly turned off.                                                                      |
| Device used by the SET and RST instructions<br>Device used by the SFT(P) instruction<br>Device used by basic instructions and application instructions | Maintains the current status.                                                             |

- Even if the MC instruction is off, the instructions between the MC and MCR instructions are executed and therefore the scan time is not shortened.

### Point

- When a ladder performing a master control includes an instruction which does not require a contact instruction (such as the FOR to NEXT instruction), the controller executes the instruction regardless of the execution command of the MC instruction.
- To create an easy-to-understand program, use the MC and MCR instructions within a single program block.
- The MC instruction can use the same nesting (N) number as many times as needed by specifying different devices in (d).
- When the MC instruction is on, the coil of the device specified by (d) turns on. Using the same device for the OUT instruction causes double coils. Do not use the device specified by (d) in other instructions.



## ■MCR

- This instruction is a master control reset instruction which indicates the end of the master control area.
- Do not place any contact instruction before the MCR instruction.
- Use the MC and MCR instructions with the same nesting number as a set. Note that if the MCR instructions are nested in one place, all master controls can be terminated by specifying the lowest nesting (N) number. (Refer to "Precautions".)

### Operation error

There is no operation error.

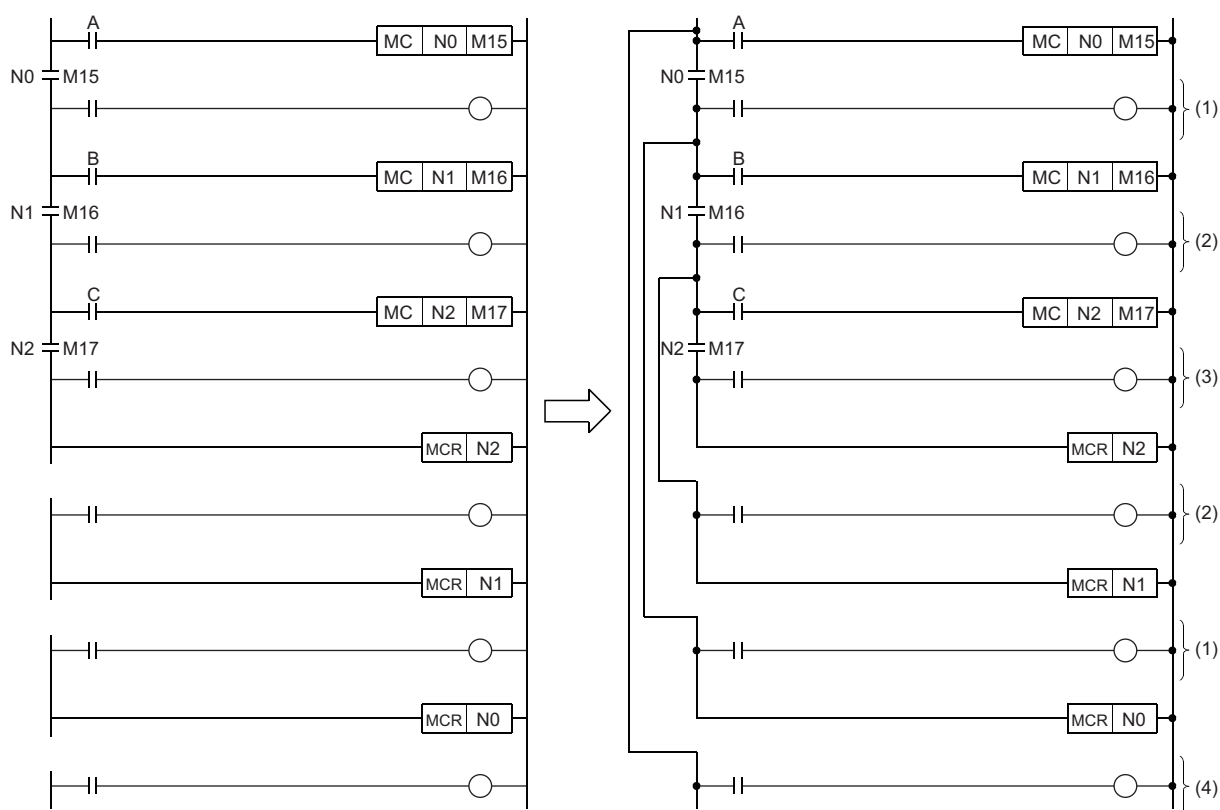
#### Point

The master control instructions can be nested. Individual master control areas are distinguished by nesting (N) numbers. Nesting can be set from N0 to N14.

Using the nesting structure enables the creation of a ladder which can sequentially constrain the program execution conditions.

The following figure shows a ladder program example using the nesting structure.

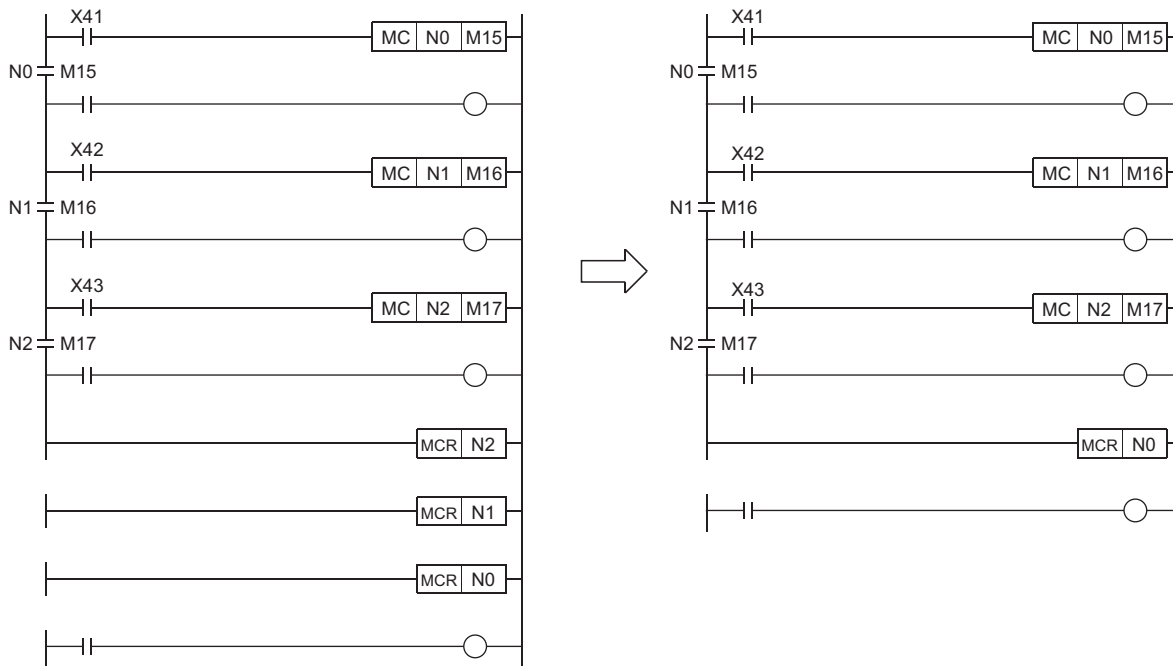
(Left: Display on the engineering tool, Right: Actual operation)



- (1) Executed when A is on.
- (2) Executed when A and B are on.
- (3) Executed when A, B, and C are on.
- (4) Executed regardless of the status of A, B, and C

## Precautions

- Up to 15 nests (N0 to N14) are allowed. When nesting is performed, the MC instruction should use nesting (N) numbers in order from lower numbers and the MCR instruction should use them in order from higher numbers.
- If the MCR instructions are nested in one place, all master controls can be terminated by specifying the lowest nesting (N) number.



# 11.6 Termination Instructions

11

## Ending the main routine program

### FEND

This instruction is used to separate the main routine program from subroutine programs and interrupt programs in a program file.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

### FBD/LD

Not supported

### Execution condition

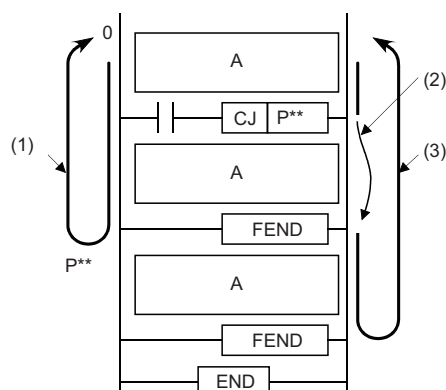
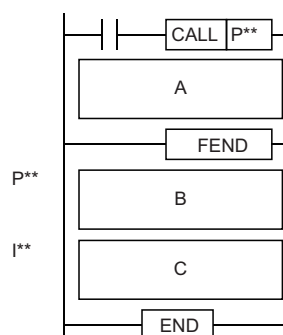
| Instruction | Execution condition |
|-------------|---------------------|
| FEND        | Every scan          |

### Processing details

- This instruction is used to divide sequence program operations by using a program branch instruction such as the CJ instruction or to separate the main routine program from subroutine programs and interrupt programs specified by the interrupt pointer (I).
- When the instruction is executed, the controller terminates the running program.
- Sequence programs following the FEND instruction can be displayed on the engineering tool (ladder mode).

When the CJ instruction is used

When there are subroutine and interrupt programs



A: Main routine program

B: Subroutine program

C: Interrupt program

(1) Operation performed when the CJ instruction is not executed

(2) Jump caused by the CJ instruction

(3) Operation performed when the CJ instruction is executed

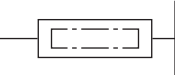
### Operation error

| Error code (SD0) | Description                                                                                                                                |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 3341H            | After execution of the CALL(P), FCALL(P), ECALL(P), or EFCALL(P) instruction, the FEND instruction is executed before the RET instruction. |
| 3351H            | Within the interrupt program specified by the interrupt pointer (I), the FEND instruction is executed before the IRET instruction.         |

# Ending the sequence program

## END

This instruction indicates the end of a program.

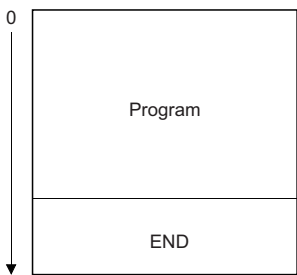
| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |
| FBD/LD                                                                            |               |
| Not supported                                                                     |               |

### Execution condition

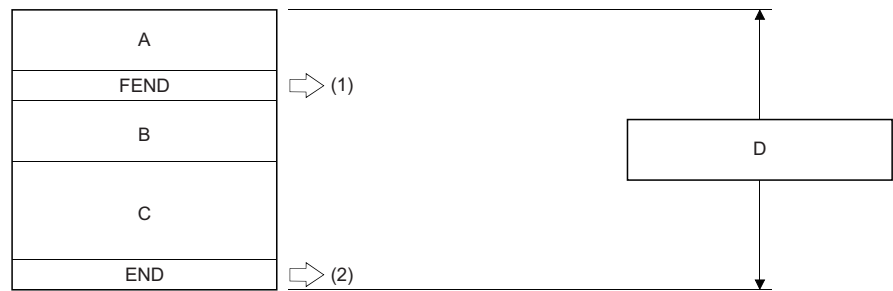
| Instruction | Execution condition |
|-------------|---------------------|
| END         | Every scan          |

### Processing details

- This instruction indicates the end of a program including a main routine program, subroutine programs, and interrupt programs.
- When the instruction is executed, the controller terminates the running program.



- If END processing is required in the middle of a program, use the FEND instruction.
- If the program is created using the engineering tool (in ladder edit mode), the END instruction is automatically input and cannot be edited.
- The following figure shows how to use the termination instructions when a main routine program, subroutine program, and interrupt program exist.



- A: Main routine program  
B: Subroutine program  
C: Interrupt program  
D: Main sequence program area  
(1) The FEND instruction is required.  
(2) The END instruction is required.



When a program is divided into multiple program blocks, the END instruction indicates the end of a program block.

The END instruction within the program registered at the end of the program setting performs END processing.

## Operation error

| Error code (SD0) | Description                                                                                                                               |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 3341H            | After execution of the CALL(P), FCALL(P), ECALL(P), or EFCALL(P) instruction, the END instruction is executed before the RET instruction. |
| 3351H            | Within the interrupt program specified by the interrupt pointer (I), the END instruction is executed before the IRET instruction.         |

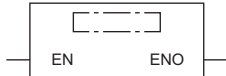
# 11.7 Stop Instruction

## Stopping the sequence program

### STOP

Stops the operation of the controller. (The operation of this instruction is the same as setting the switch of the controller to the STOP position.)

| Ladder                                                                            | ST             |
|-----------------------------------------------------------------------------------|----------------|
|  | ENO:=STOP(EN); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| STOP        |  |

### Processing details

- This instruction resets the output (Y) and stops the operation of the controller when the execution command turns on. (The operation of this instruction is the same as setting the switch of the controller to the STOP position.)
- To restart the operation of the controller after execution of the STOP instruction, set the switch back to STOP, and then set it to RUN again.

### Operation error

| Error code (SD0) | Description                                                                                                                                       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 3341H            | After execution of the CALL(P), FCALL(P), ECALL(P), EFCALL(P), or XCALL instruction, the STOP instruction is executed before the RET instruction. |
| 3351H            | Within the interrupt program specified by the interrupt pointer (I), the STOP instruction is executed before the IRET instruction.                |
| 3353H            | The STOP instruction is executed within a fixed scan execution type program.                                                                      |
| 3354H            | The STOP instruction is executed within an event execution type program.                                                                          |

# 11.8 No Operation Instruction

## No operation (NOPLF)

### NOPLF

This instruction is a no-operation instruction and has no impact on the previous operations.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

| FBD/LD        |
|---------------|
| Not supported |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| NOPLF       | Every scan          |

### Processing details

This instruction is a no-operation instruction and has no impact on the previous operations.

### Operation error

There is no operation error.

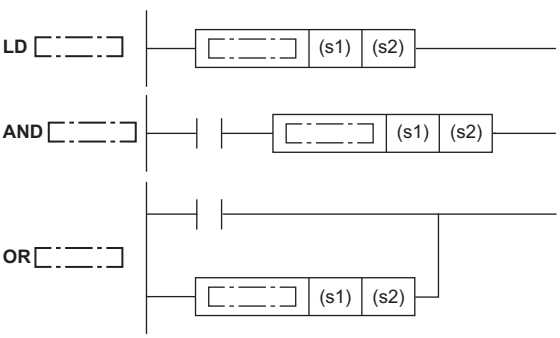
# 12 BASIC INSTRUCTIONS

## 12.1 Comparison Operation Instructions

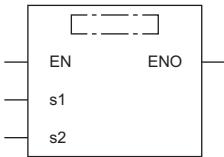
### Comparing 16-bit binary data

#### LD□(\_U), AND□(\_U), OR□(\_U)

These instructions compare the two sets of 16-bit binary data specified. (Devices are used as normally open contacts.)

| Ladder                                                                                                                                                                                                  | ST                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>(□ is to be replaced by any of the following: =( _U), &lt;&gt;(_U), &gt;(_U), &lt;=(_U), &lt;(_U), &gt;=(_U).)</p> | <div>ENO:=LD_□(EN,s1,s2);</div> <div>ENO:=AND_□(EN,s1,s2);</div> <div>ENO:=OR_□(EN,s1,s2);</div> <div>ENO:=LD_□_U(EN,s1,s2);</div> <div>ENO:=AND_□_U(EN,s1,s2);</div> <div>ENO:=OR_□_U(EN,s1,s2);</div> <div>(□ is replaced by any of the following: EQ, NE, GT, LE, LT, GE.)*1</div> |

#### FBD/LD



(□ is to be replaced by combination of any of the following: LD\_, AND\_, OR\_ and EQ(\_U), NE(\_U), GT(\_U), LE(\_U), LT(\_U), GE(\_U).)\*1

\*1 EQ indicates =, NE indicates <>, GT indicates >, LE indicates <=, LT indicates <, and GE indicates >=.

#### ■Execution condition

| Instruction                | Execution condition |
|----------------------------|---------------------|
| LD□(_U), AND□(_U), OR□(_U) | Every scan          |



## Setting data

### ■Description, range, data type

| Operand | Description          | Range           | Data type              | Data type (label) |
|---------|----------------------|-----------------|------------------------|-------------------|
| (s1)    | LD□, AND□, OR□       | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | LD□_U, AND□_U, OR□_U | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (s2)    | LD□, AND□, OR□       | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | LD□_U, AND□_U, OR□_U | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition  | —               | Bit                    | BOOL              |
| ENO     | Execution result     | —               | Bit                    | BOOL              |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions perform a comparison operation between the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2). (Devices are used as normally open contacts.)
- The following table lists the comparison operation results of each instruction.

| Instruction symbol (ladder, FBD/LD) | Condition | Result                             |
|-------------------------------------|-----------|------------------------------------|
| =(_U), EQ(_U)                       | (s1)=(s2) | Continuity state (ENO is on.)      |
| <>(_U), NE(_U)                      | (s1)≠(s2) |                                    |
| >(_U), GT(_U)                       | (s1)>(s2) |                                    |
| <=(_U), LE(_U)                      | (s1)≤(s2) |                                    |
| <(_U), LT(_U)                       | (s1)<(s2) |                                    |
| >=(_U), GE(_U)                      | (s1)≥(s2) | Non-continuity state (ENO is off.) |
| =(_U), EQ(_U)                       | (s1)≠(s2) |                                    |
| <>(_U), NE(_U)                      | (s1)=(s2) |                                    |
| >(_U), GT(_U)                       | (s1)≤(s2) |                                    |
| <=(_U), LE(_U)                      | (s1)>(s2) |                                    |
| <(_U), LT(_U)                       | (s1)≥(s2) |                                    |
| >=(_U), GE(_U)                      | (s1)<(s2) |                                    |

- When hexadecimal constants are used for (s1) and (s2) and the numerical value (8 to F) whose most significant bit (b15) is 1 is specified as a constant, the value is considered as a negative binary value in comparison operation.
- If the LD□ instruction is used in the program written in FBD/LD, use a left rail or a variable/constant which is always on for EN.
- If the OR□ instruction is used in the program written in FBD/LD and EN is set to TRUE, ENO turns on. EN will not be an execution condition.

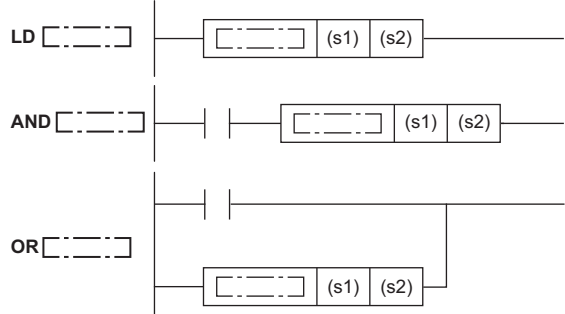
## Operation error

There is no operation error.

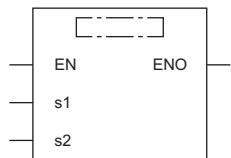
# Comparing 32-bit binary data

## LDD□(\_U), ANDDD□(\_U), ORD□(\_U)

These instructions compare the two sets of 32-bit binary data specified. (Devices are used as normally open contacts.)

| Ladder                                                                                                                                                                                                       | ST                                                                             |                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
|  <p>(□ is to be replaced by any of the following: D=(_U), D&lt;&gt;(_U), D&gt;(_U), D&lt;=(_U), D&lt;(_U), D&gt;=(_U).)</p> | ENO:=LDD_□(EN,s1,s2);<br>ENO:=ANDDD_□(EN,s1,s2);<br>ENO:=ORD_□(EN,s1,s2);      | ENO:=LDD_□_U(EN,s1,s2);<br>ENO:=ANDDD_□_U(EN,s1,s2);<br>ENO:=ORD_□_U(EN,s1,s2); |
|                                                                                                                                                                                                              | (□ is replaced by any of the following: EQ, NE, GT, LE, LT, GE.) <sup>*1</sup> |                                                                                 |
|                                                                                                                                                                                                              |                                                                                |                                                                                 |

## FBD/LD



(□ is to be replaced by combination of any of the following: LDD\_, ANDDD\_, ORD\_ and EQ(\_U), NE(\_U), GT(\_U), LE(\_U), LT(\_U), GE(\_U).)<sup>\*1</sup>

<sup>\*1</sup> EQ indicates =, NE indicates <>, GT indicates >, LE indicates <=, LT indicates <, and GE indicates >=.

### Execution condition

| Instruction                       | Execution condition |
|-----------------------------------|---------------------|
| LDD□(_U), ANDDD□(_U),<br>ORD□(_U) | Every scan          |

## Setting data

### ■Description, range, data type

| Operand                  | Description                                                             | Range                     | Data type              | Data type (label) |
|--------------------------|-------------------------------------------------------------------------|---------------------------|------------------------|-------------------|
| (s1) LDD□, ANDDD□, ORD□  | Comparison data or the start device where the comparison data is stored | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
| LDD□_U, ANDDD□_U, ORD□_U |                                                                         | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (s2) LDD□, ANDDD□, ORD□  | Comparison data or the start device where the comparison data is stored | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
| LDD□_U, ANDDD□_U, ORD□_U |                                                                         | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| EN                       | Execution condition                                                     | —                         | Bit                    | BOOL              |
| ENO                      | Execution result                                                        | —                         | Bit                    | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions perform a comparison operation between the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2). (Devices are used as normally open contacts.)
- The following table lists the comparison operation results of each instruction.

| Instruction symbol (ladder, FBD/LD) | Condition | Result                             |
|-------------------------------------|-----------|------------------------------------|
| D=(_U), EQ(_U)                      | (s1)=(s2) | Continuity state (ENO is on.)      |
| D<>(_U), NE(_U)                     | (s1)≠(s2) |                                    |
| D>(_U), GT(_U)                      | (s1)>(s2) |                                    |
| D<=(_U), LE(_U)                     | (s1)≤(s2) |                                    |
| D<(_U), LT(_U)                      | (s1)<(s2) |                                    |
| D>=(_U), GE(_U)                     | (s1)≥(s2) |                                    |
| D=(_U), EQ(_U)                      | (s1)≠(s2) | Non-continuity state (ENO is off.) |
| D<>(_U), NE(_U)                     | (s1)=(s2) |                                    |
| D>(_U), GT(_U)                      | (s1)≤(s2) |                                    |
| D<=(_U), LE(_U)                     | (s1)>(s2) |                                    |
| D<(_U), LT(_U)                      | (s1)≥(s2) |                                    |
| D>=(_U), GE(_U)                     | (s1)<(s2) |                                    |

- When hexadecimal constants are specified for (s1) and (s2) and the numerical value (8 to F) whose most significant bit (b31) is 1 is specified as a constant, the value is considered as a negative binary value in comparison operation.
- To specify the compare target data, use an instruction which handles 32-bit data, such as the DMOV(P) instruction. If an instruction which handles 16-bit data, such as the MOV(P) instruction, is used, comparison cannot be performed normally.
- If the LDD□ instruction is used in the program written in FBD/LD, use a left rail or a variable/constant which is always on for EN.
- If the ORD□ instruction is used in the program written in FBD/LD and EN is set to TRUE, ENO turns on. EN will not be an execution condition.

## Operation error

There is no operation error.

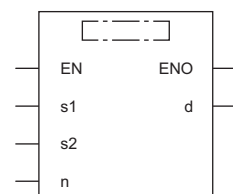
# Comparing 16-bit binary block data

## BKCMPP(P)(U)

These instructions compare the two sets of 16-bit binary block data specified.

| Ladder                                                                                                                                                   | ST                                                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(□ is replaced by any of the following: BKCMP=(P)(U), BKCMP&lt;&gt;(P)(U), BKCMP&gt;(P)(U), BKCMP&lt;=(P)(U), BKCMP&lt;(P)(U), BKCMP&gt;=(P)(U).)</p> | <div>ENO:=BKCMP_□(EN,s1,s2,n,d);</div> <div>ENO:=BKCMP_□P(EN,s1,s2,n,d);</div> <div>ENO:=BKCMP_□_U(EN,s1,s2,n,d);</div> <div>(□ is replaced by any of the following: EQ, NE, GT, LE, LT, GE.)<sup>*1</sup></div> |

## FBD/LD



(□ is to be replaced by combination of any of the following: BKCMP\_ and EQ(P)(U), NE(P)(U), GT(P)(U), LE(P)(U), LT(P)(U), GE(P)(U).)<sup>\*1</sup>

<sup>\*1</sup> EQ indicates =, NE indicates <>, GT indicates >, LE indicates <=, LT indicates <, and GE indicates >=.

## Execution condition

| Instruction  | Execution condition |
|--------------|---------------------|
| BKCMPP(U)    |                     |
| BKCMPP(P)(U) |                     |

## Setting data

## Description, range, data type

| Operand | Description                                              | Range           | Data type              | Data type (label)      |
|---------|----------------------------------------------------------|-----------------|------------------------|------------------------|
| (s1)    | BKCMPP(P)                                                | -32768 to 32767 | 16-bit signed binary   | ANY16_S <sup>*1</sup>  |
|         | BKCMPP(P)_U                                              | 0 to 65535      | 16-bit unsigned binary | ANY16_U <sup>*1</sup>  |
| (s2)    | BKCMPP(P)                                                | —               | 16-bit signed binary   | ANY16_S <sup>*1</sup>  |
|         | BKCMPP(P)_U                                              | —               | 16-bit unsigned binary | ANY16_U <sup>*1</sup>  |
| (d)     | Start device for storing the comparison operation result | —               | Bit                    | ANY_BOOL <sup>*1</sup> |
| (n)     | Number of data points to be compared                     | 0 to 65535      | 16-bit unsigned binary | ANY16                  |
| EN      | Execution condition                                      | —               | Bit                    | BOOL                   |
| ENO     | Execution result                                         | —               | Bit                    | BOOL                   |

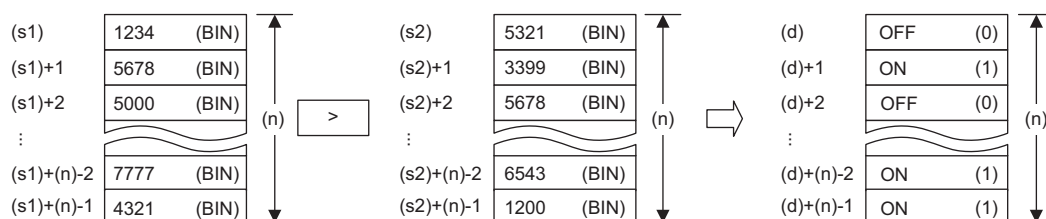
<sup>\*1</sup> When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

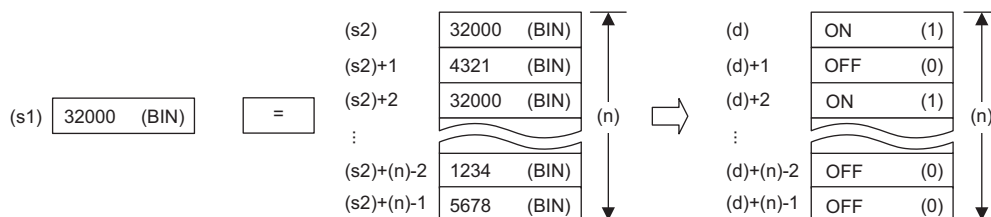
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | — |        |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | — |        |
| (d)     | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | — |        |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | — |        |

## Processing details

- These instructions compare the (n) points of 16-bit binary data from the device specified by (s1) with the (n) points of 16-bit binary data from the device specified by (s2), and stores the operation result in the device specified by (d) and later.
- If the comparison condition is satisfied, the relevant device specified by (d) turns on; otherwise, the device turns off.



- Specify data in units of 16 bits.
- A constant can be specified for (s1).



- The following table lists the comparison operation results of each instruction.

| Instruction symbol (ladder, FBD/LD) | Condition | Result  |
|-------------------------------------|-----------|---------|
| BKCOMP=(P)(_U), BKCOMP_EQ(P)(_U)    | (s1)=(s2) | On (1)  |
| BKCOMP<>(P)(_U), BKCOMP_NE(P)(_U)   | (s1)≠(s2) |         |
| BKCOMP>(P)(_U), BKCOMP_GT(P)(_U)    | (s1)>(s2) |         |
| BKCOMP<=(P)(_U), BKCOMP_LE(P)(_U)   | (s1)≤(s2) |         |
| BKCOMP<(P)(_U), BKCOMP_LT(P)(_U)    | (s1)<(s2) |         |
| BKCOMP>=(P)(_U), BKCOMP_GE(P)(_U)   | (s1)≥(s2) |         |
| BKCOMP=(P)(_U), BKCOMP_EQ(P)(_U)    | (s1)≠(s2) | Off (0) |
| BKCOMP<>(P)(_U), BKCOMP_NE(P)(_U)   | (s1)=(s2) |         |
| BKCOMP>(P)(_U), BKCOMP_GT(P)(_U)    | (s1)≤(s2) |         |
| BKCOMP<=(P)(_U), BKCOMP_LE(P)(_U)   | (s1)>(s2) |         |
| BKCOMP<(P)(_U), BKCOMP_LT(P)(_U)    | (s1)≥(s2) |         |
| BKCOMP>=(P)(_U), BKCOMP_GE(P)(_U)   | (s1)<(s2) |         |

- When the comparison operation results stored in (n) points from the device specified by (d) are all on (1), SM704 turns on.

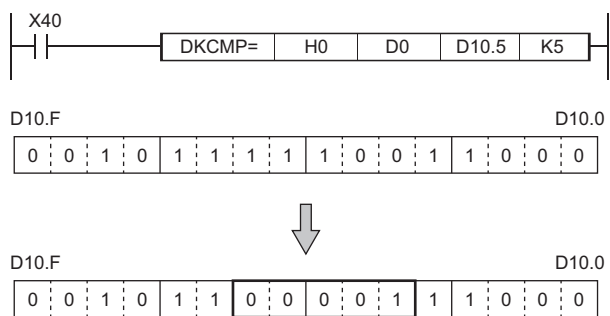
## Operation error

| Error code (SD0) | Description                                                                         |
|------------------|-------------------------------------------------------------------------------------|
| 2821H            | The device ranges starting from the ones specified by (s1) and (d) are overlapping. |
|                  | The device ranges starting from the ones specified by (s2) and (d) are overlapping. |

### Point

When bits of a word device are specified, the bits other than the specified ones for storing the operation result do not change as shown below.

- Number of data points to be compared (n): K5
- Start number of the device for storing the comparison operation result (d): D10.5



# Comparing 32-bit binary block data

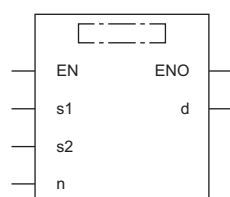
12

## DBKCMPP(P)(U)

These instructions compare the two sets of 32-bit binary block data specified.

| Ladder                                                                                                                                                              | ST                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(□ is replaced by any of the following: DBKCMPP(P)(U), DBKCMPP&lt;&gt;(P)(U), DBKCMPP&gt;(P)(U), DBKCMPP&lt;=(P)(U), DBKCMPP&lt;(P)(U), DBKCMPP&gt;=(P)(U).)</p> | <pre> ENO:=DBKCMPP_□(EN,s1,s2,n,d); ENO:=DBKCMPP_□P(EN,s1,s2,n,d); ; ENO:=DBKCMPP_□P_U(EN,s1,s2,n,d); </pre> <p>(□ is replaced by any of the following: EQ, NE, GT, LE, LT, GE.)*1</p> |

## FBD/LD



(□ is to be replaced by combination of any of the following: DBKCMPP\_ and EQ(P)(U), NE(P)(U), GT(P)(U), LE(P)(U), LT(P)(U), GE(P)(U).)\*1

\*1 EQ indicates =, NE indicates <>, GT indicates >, LE indicates <=, LT indicates <, and GE indicates >=.

## Execution condition

| Instruction   | Execution condition |
|---------------|---------------------|
| DBKCMPP(P)(U) |                     |
| DBKCMPP(P)(U) |                     |

## Setting data

## Description, range, data type

| Operand | Description                                              | Range                     | Data type              | Data type (label) |
|---------|----------------------------------------------------------|---------------------------|------------------------|-------------------|
| (s1)    | DBKCMPP(P)                                               | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S*1         |
|         | DBKCMPP(P)_U                                             | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U*1         |
| (s2)    | DBKCMPP(P)                                               | —                         | 32-bit signed binary   | ANY32_S*1         |
|         | DBKCMPP(P)_U                                             | —                         | 32-bit unsigned binary | ANY32_U*1         |
| (d)     | Start device for storing the comparison operation result | —                         | Bit                    | ANY_BOOL*1        |
| (n)     | Number of data points to be compared                     | 0 to 65535                | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition                                      | —                         | Bit                    | BOOL              |
| ENO     | Execution result                                         | —                         | Bit                    | BOOL              |

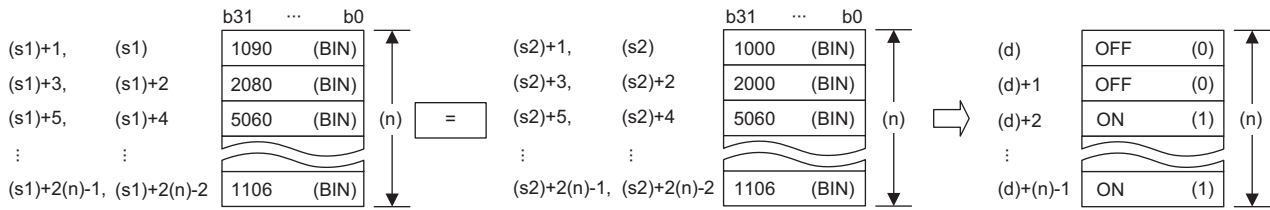
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

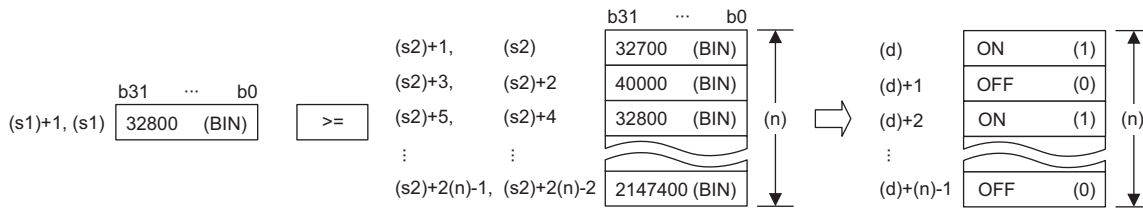
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions compare the (n) points of 32-bit binary data from the device specified by (s1) with the (n) points of 32-bit binary data from the device specified by (s2), and stores the operation result in the device specified by (d) and later.
- If the comparison condition is satisfied, the relevant device specified by (d) turns on; otherwise, the device turns off.



- Comparison operation is performed in units of 32 bits.
- A constant can be specified for (s1).



- Specify (d) outside the device ranges for (n) points from the device specified by (s1) and those from the device specified by (s2).
- The following table lists the comparison operation results of each instruction.

| Instruction symbol (ladder, FBD/LD) | Condition | Result  |
|-------------------------------------|-----------|---------|
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)=(s2) | On (1)  |
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)≠(s2) |         |
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)>(s2) |         |
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)≤(s2) |         |
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)<(s2) |         |
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)≥(s2) |         |
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)≠(s2) | Off (0) |
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)=(s2) |         |
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)≤(s2) |         |
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)>(s2) |         |
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)≥(s2) |         |
| DBKCMPEQ(P)(_U), DBKCMPEQ(P)(_U)    | (s1)<(s2) |         |

- When the comparison operation results stored in (n) points from the device specified by (d) are all on (1), SM704 turns on.
- If (n) is 0, no processing is performed.

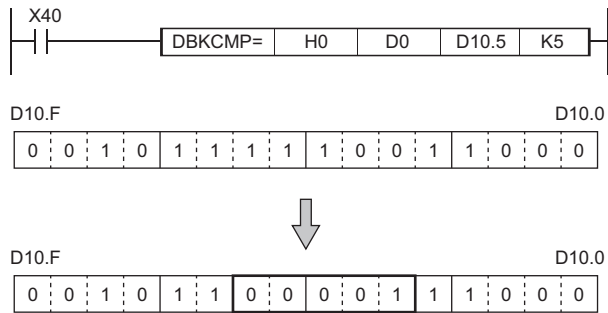


| Error code (SD0) | Description                                                                         |
|------------------|-------------------------------------------------------------------------------------|
| 2821H            | The device ranges starting from the ones specified by (s1) and (d) are overlapping. |
|                  | The device ranges starting from the ones specified by (s2) and (d) are overlapping. |

## Point

When bits of a word device are specified, the bits other than the specified ones for storing the operation result do not change as shown below.

- Number of data points to be compared (n): K5
- Start number of the device for storing the comparison operation result (d): D10.5

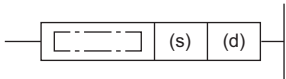


# 12.2 Arithmetic Operation Instructions

## Adding 16-bit binary data

### +(P)(\_U) [when two operands are set]

These instructions add the two sets of 16-bit binary data specified.

| Ladder                                                                            | ST                                                                                                                                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Not supported<br>(  Page 270 +(P)(_U) [when three operands are set]) |

| FBD/LD                                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Not supported<br>(  Page 270 +(P)(_U) [when three operands are set]) |

### ■Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| +<br>+_U    |  |
| +P<br>+P_U  |  |

### Setting data

### ■Description, range, data type

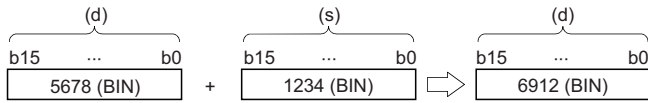
| Operand | Description                                                             | Range           | Data type              | Data type (label) |
|---------|-------------------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Second addend data or the device where the second addend data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         |                                                                         | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (d)     | Device where the first addend data is stored                            | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         |                                                                         | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

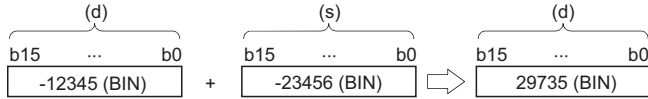
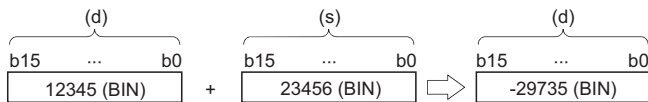
## Processing details

- These instructions add the 16-bit binary data in the device specified by (d) and the 16-bit binary data in the device specified by (s), and store the operation result in the device specified by (d).

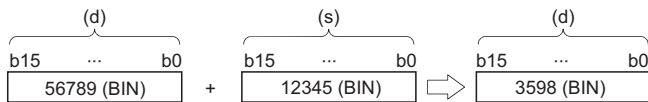


- If an overflow occurs in the result, the carry bit is ignored. In this case, SM700 does not turn on.

[+(P) instruction]



[+(P)\_U instruction]



## Operation error

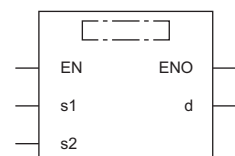
There is no operation error.

## + (P) ( \_ U) [when three operands are set]

These instructions add the two sets of 16-bit binary data specified.

| Ladder | ST                                                                                                         |
|--------|------------------------------------------------------------------------------------------------------------|
|        | ENO:=PLUS(EN,s1,s2,d);<br>ENO:=PLUSP(EN,s1,s2,d);<br>ENO:=PLUS_U(EN,s1,s2,d);<br>ENO:=PLUSP_U(EN,s1,s2,d); |

## FBD/LD



(□ is to be replaced by any of the following: PLUS, PLUSP, PLUS\_U, PLUSP\_U.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| +<br>+_U    |                     |
| +P<br>+P_U  |                     |

## Setting data

## Description, range, data type

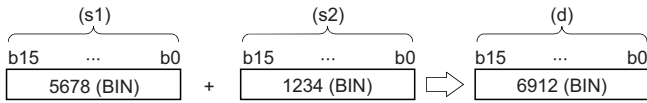
| Operand | Description         | Range           | Data type              | Data type (label) |
|---------|---------------------|-----------------|------------------------|-------------------|
| (s1)    | + (P)               | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | + (P) _ U           | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (s2)    | + (P)               | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | + (P) _ U           | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (d)     | + (P)               | —               | 16-bit signed binary   | ANY16_S           |
|         | + (P) _ U           | —               | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition | —               | Bit                    | BOOL              |
| ENO     | Execution result    | —               | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

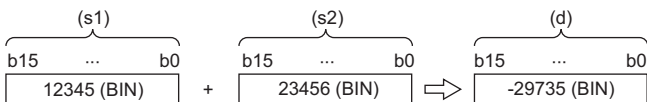
## Processing details

- These instructions add the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).

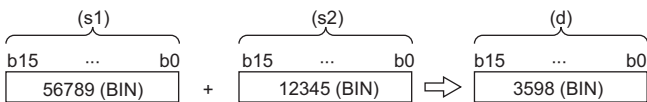


- If an overflow occurs in the result, the carry bit is ignored. In this case, SM700 does not turn on.

[+(P) instruction]



[+(P)\_U instruction]



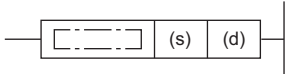
## Operation error

There is no operation error.

# Subtracting 16-bit binary data

## -(P)(\_U) [when two operands are set]

These instructions perform subtraction between the two sets of 16-bit binary data specified.

| Ladder                                                                            | ST                                                                                                                                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Not supported<br>(  Page 274 -(P)(_U) [when three operands are set]) |

| FBD/LD                                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Not supported<br>(  Page 274 -(P)(_U) [when three operands are set]) |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| -<br>-_U    |  |
| -P<br>-P_U  |  |

### Setting data

### Description, range, data type

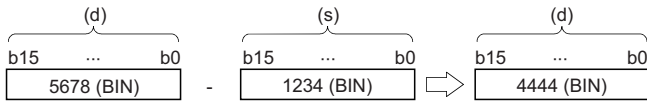
| Operand | Description                                                   | Range           | Data type              | Data type (label) |
|---------|---------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Subtrahend data or the device where subtrahend data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         |                                                               | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (d)     | Device where minuend data is stored                           | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         |                                                               | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

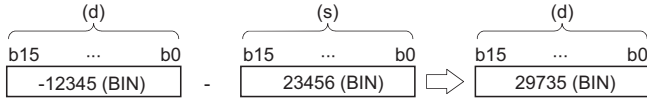
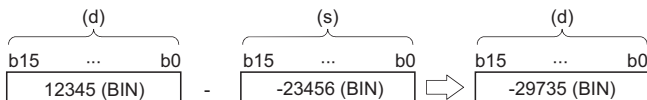
## Processing details

- These instructions subtract the 16-bit binary data in the device specified by (s) from the 16-bit binary data in the device specified by (d), and store the operation result in the device specified by (d).



- If an underflow occurs in the result, the borrow bit is ignored. In this case, SM700 does not turn on.

[-(P) instruction]



[-(P)\_U instruction]



## Operation error

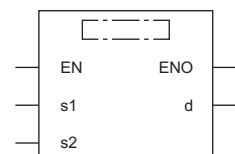
There is no operation error.

## -(P)(\_U) [when three operands are set]

These instructions perform subtraction between the two sets of 16-bit binary data specified.

| Ladder | ST                                                                                                             |
|--------|----------------------------------------------------------------------------------------------------------------|
|        | ENO:=MINUS(EN,s1,s2,d);<br>ENO:=MINUSP(EN,s1,s2,d);<br>ENO:=MINUS_U(EN,s1,s2,d);<br>ENO:=MINUSP_U(EN,s1,s2,d); |

### FBD/LD



(□ is to be replaced by any of the following: MINUS, MINUSP, MINUS\_U, MINUSP\_U.)

## ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| -<br>-_U    |                     |
| -P<br>-P_U  |                     |

## Setting data

## ■Description, range, data type

| Operand | Description         | Range           | Data type              | Data type (label) |
|---------|---------------------|-----------------|------------------------|-------------------|
| (s1)    | -(P)                | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | -(P)_U              | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (s2)    | -(P)                | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | -(P)_U              | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (d)     | -(P)                | —               | 16-bit signed binary   | ANY16_S           |
|         | -(P)_U              | —               | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition | —               | Bit                    | BOOL              |
| ENO     | Execution result    | —               | Bit                    | BOOL              |

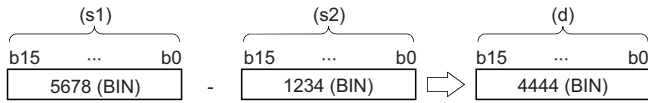
## ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |



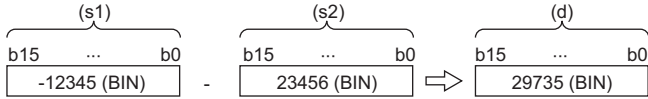
## Processing details

- These instructions subtract the 16-bit binary data in the device specified by (s2) from the 16-bit binary data in the device specified by (s1), and store the operation result in the device specified by (d).

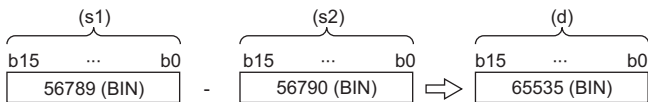


- If an underflow occurs in the result, the borrow bit is ignored. In this case, SM700 does not turn on.

[-(P) instruction]



[-(P)\_U instruction]



## Operation error

There is no operation error.

# Adding 32-bit binary data

## D+(P)(\_U) [when two operands are set]

These instructions add the two sets of 32-bit binary data specified.

| Ladder                                                                | ST                                                                    |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------|
|                                                                       | Not supported<br>(  Page 278 D+(P)(_U) [when three operands are set]) |
| FBD/LD                                                                |                                                                       |
| Not supported<br>(  Page 278 D+(P)(_U) [when three operands are set]) |                                                                       |

## Execution condition

| Instruction  | Execution condition |
|--------------|---------------------|
| D+<br>D+_U   |                     |
| D+P<br>D+P_U |                     |

## Setting data

## Description, range, data type

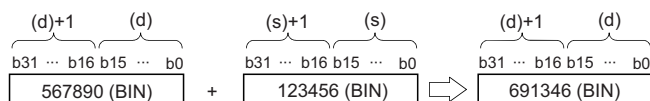
| Operand | Description | Range                     | Data type              | Data type (label) |
|---------|-------------|---------------------------|------------------------|-------------------|
| (s)     | D+(P)       | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | D+(P)_U     | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (d)     | D+(P)       | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | D+(P)_U     | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

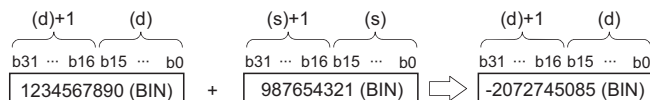
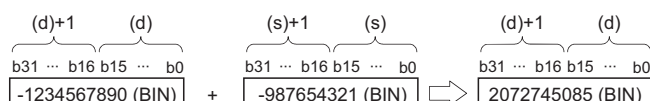
## Processing details

- These instructions add the 32-bit binary data in the device specified by (d) and the 32-bit binary data in the device specified by (s), and store the operation result in the device specified by (d).

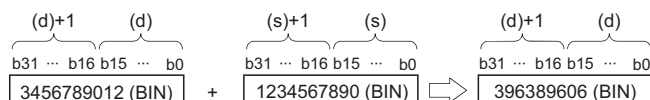


- If an overflow occurs in the result, the carry bit is ignored. In this case, SM700 does not turn on.

[D+(P) instruction]



[D+(P)\_U instruction]



## Operation error

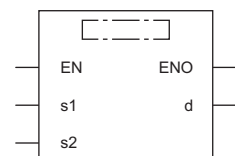
There is no operation error.

## D+(P)(\_U) [when three operands are set]

These instructions add the two sets of 32-bit binary data specified.

| Ladder | ST                                                                                                             |
|--------|----------------------------------------------------------------------------------------------------------------|
|        | ENO:=DPLUS(EN,s1,s2,d);<br>ENO:=DPLUSP(EN,s1,s2,d);<br>ENO:=DPLUS_U(EN,s1,s2,d);<br>ENO:=DPLUSP_U(EN,s1,s2,d); |

### FBD/LD



(□ is to be replaced by any of the following: DPLUS, DPLUSP, DPLUS\_U, DPLUSP\_U.)

## Execution condition

| Instruction  | Execution condition |
|--------------|---------------------|
| D+<br>D+_U   |                     |
| D+P<br>D+P_U |                     |

## Setting data

## Description, range, data type

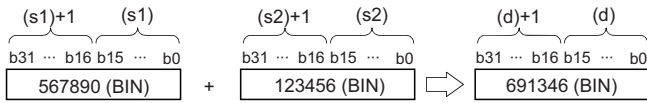
| Operand | Description         | Range                     | Data type              | Data type (label) |
|---------|---------------------|---------------------------|------------------------|-------------------|
| (s1)    | D+(P)               | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | D+(P)_U             | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (s2)    | D+(P)               | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | D+(P)_U             | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (d)     | D+(P)               | —                         | 32-bit signed binary   | ANY32_S           |
|         | D+(P)_U             | —                         | 32-bit unsigned binary | ANY32_U           |
| EN      | Execution condition | —                         | Bit                    | BOOL              |
| ENO     | Execution result    | —                         | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○           | ○           | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○           | ○           | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○           | ○           | ○                      | —        | — | —  | —      |

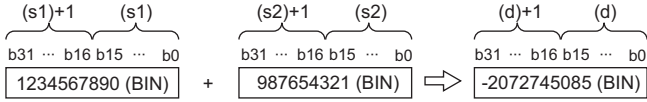
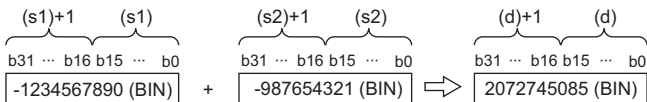
## Processing details

- These instructions add the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).

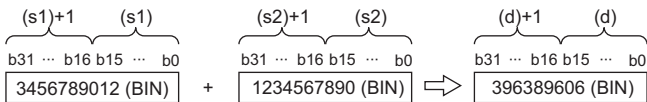


- If an overflow occurs in the result, the carry bit is ignored. In this case, SM700 does not turn on.

[D+(P) instruction]



[D+(P)\_U instruction]



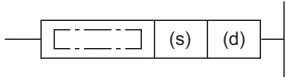
## Operation error

There is no operation error.

# Subtracting 32-bit binary data

## D-(P)(\_U) [when two operands are set]

These instructions perform subtraction between the two sets of 32-bit binary data specified.

| Ladder                                                                            | ST                                                                                                                                                     |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Not supported<br>(  Page 282 D-(P)(_U) [when three operands are set]) |

| FBD/LD                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Not supported<br>(  Page 282 D-(P)(_U) [when three operands are set]) |

### Execution condition

| Instruction  | Execution condition                                                               |
|--------------|-----------------------------------------------------------------------------------|
| D-<br>D-_U   |  |
| D-P<br>D-P_U |  |

### Setting data

### Description, range, data type

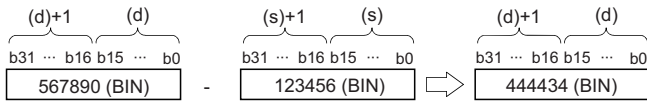
| Operand | Description | Range                     | Data type              | Data type (label) |
|---------|-------------|---------------------------|------------------------|-------------------|
| (s)     | D-(P)       | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | D-(P)_U     | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (d)     | D-(P)       | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | D-(P)_U     | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

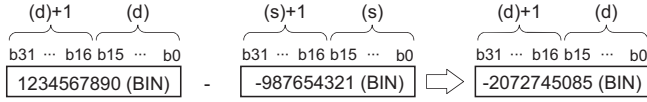
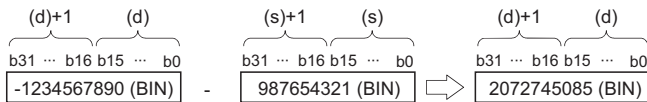
## Processing details

- These instructions subtract the 32-bit binary data in the device specified by (s) from the 32-bit binary data in the device specified by (d) and, and store the operation result in the device specified by (d).

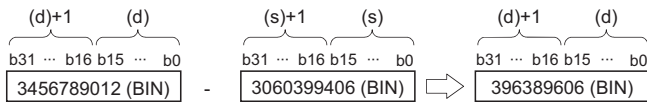


- If an underflow occurs in the result, the carry bit is ignored. In this case, SM700 does not turn on.

[D-(P) instruction]



[D-(P)\_U instruction]



## Operation error

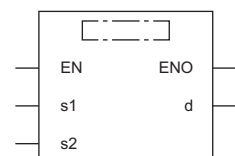
There is no operation error.

## D-(P)(U) [when three operands are set]

These instructions perform subtraction between the two sets of 32-bit binary data specified.

| Ladder | ST                                                                                                                 |
|--------|--------------------------------------------------------------------------------------------------------------------|
|        | ENO:=DMINUS(EN,s1,s2,d);<br>ENO:=DMINUSP(EN,s1,s2,d);<br>ENO:=DMINUS_U(EN,s1,s2,d);<br>ENO:=DMINUSP_U(EN,s1,s2,d); |

### FBD/LD



(□ is to be replaced by any of the following: DMINUS, DMINUSP, DMINUS\_U, DMINUSP\_U.)

### ■Execution condition

| Instruction  | Execution condition |
|--------------|---------------------|
| D-<br>D_U    |                     |
| D-P<br>D-P_U |                     |

### Setting data

### ■Description, range, data type

| Operand |         | Description                                                         | Range                     | Data type              | Data type (label) |
|---------|---------|---------------------------------------------------------------------|---------------------------|------------------------|-------------------|
| (s1)    | D-(P)   | Minuend data or the start device where minuend data is stored       | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | D-(P)_U |                                                                     | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (s2)    | D-(P)   | Subtrahend data or the start device where subtrahend data is stored | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | D-(P)_U |                                                                     | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (d)     | D-(P)   | Start device for storing the operation result                       | —                         | 32-bit signed binary   | ANY32_S           |
|         | D-(P)_U |                                                                     |                           | 32-bit unsigned binary | ANY32_U           |
| EN      |         | Execution condition                                                 | —                         | Bit                    | BOOL              |
| ENO     |         | Execution result                                                    | —                         | Bit                    | BOOL              |

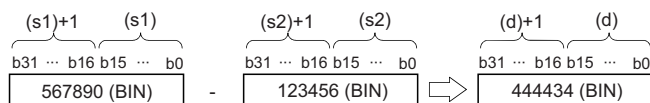
### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |



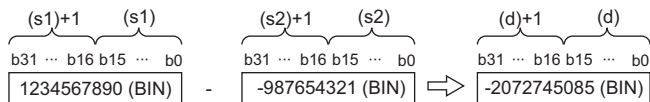
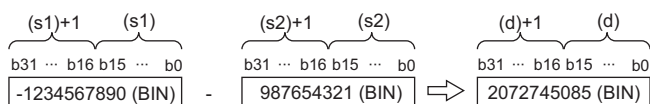
## Processing details

- These instructions subtracts the 32-bit binary data in the device specified by (s2) from the 32-bit binary data in the device specified by (s1), and store the operation result in the device specified by (d).

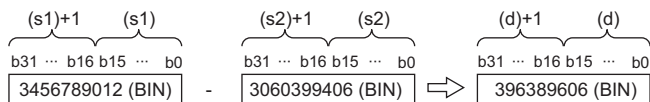


- If an underflow occurs in the result, the carry bit is ignored. In this case, SM700 does not turn on.

[D-(P) instruction]



[D-(P)\_U instruction]



## Operation error

There is no operation error.

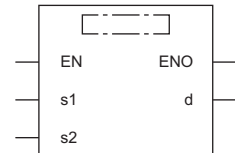
# Multiplying 16-bit binary data

## \*(P)(\_U)

These instructions multiply the two sets of 16-bit binary data specified.

| Ladder | ST                                                  |                                                         |
|--------|-----------------------------------------------------|---------------------------------------------------------|
|        | ENO:=MULTI(EN,s1,s2,d);<br>ENO:=MULTIP(EN,s1,s2,d); | ENO:=MULTI_U(EN,s1,s2,d);<br>ENO:=MULTIP_U(EN,s1,s2,d); |

## FBD/LD



(□ is to be replaced by any of the following: MULTI, MULTIP, MULTI\_U, MULTIP\_U.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| *<br>*_U    |                     |
| *P<br>*P_U  |                     |

## Setting data

## Description, range, data type

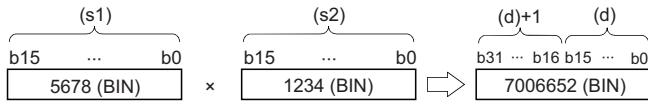
| Operand | Description                                                               | Range           | Data type              | Data type (label) |
|---------|---------------------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s1)    | *(P)<br>Multiplicand data or the device where multiplicand data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         |                                                                           | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (s2)    | *(P)<br>Multiplier data or the device where multiplier data is stored     | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         |                                                                           | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (d)     | *(P)<br>Start device for storing the operation result                     | —               | 32-bit signed binary   | ANY32_S           |
|         |                                                                           |                 | 32-bit unsigned binary | ANY32_U           |
| EN      | Execution condition                                                       | —               | Bit                    | BOOL              |
| ENO     | Execution result                                                          | —               | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions multiply the 16-bit binary data in the device specified by (s1) by the 16-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



- When (d) is a bit device, data should be specified in order from lower bits.

### Ex.

Operation result when (d) is a bit device

- K1...Lower 4 bits (b0 to b3)
- K4...Lower 16 bits (b0 to b15)
- K8...Lower 32 bits (b0 to b31)

## Operation error

There is no operation error.

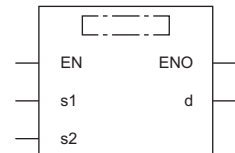
# Dividing 16-bit binary data

## / (P) ( \_ U)

These instructions perform division between the two sets of 16-bit binary data specified.

| Ladder | ST                                                        |                                                               |
|--------|-----------------------------------------------------------|---------------------------------------------------------------|
|        | ENO:=DIVISION(EN,s1,s2,d);<br>ENO:=DIVISIONP(EN,s1,s2,d); | ENO:=DIVISION_U(EN,s1,s2,d);<br>ENO:=DIVISIONP_U(EN,s1,s2,d); |

## FBD/LD



(□ is to be replaced by any of the following: DIVISION, DIVISIONP, DIVISION\_U, DIVISIONP\_U.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| /<br>/_U    |                     |
| /P<br>/P_U  |                     |

## Setting data

## Description, range, data type

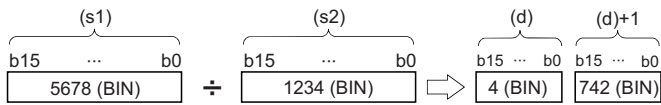
| Operand  | Description                                               | Range           | Data type              | Data type (label)                        |
|----------|-----------------------------------------------------------|-----------------|------------------------|------------------------------------------|
| (s1)     | Dividend data or the device where dividend data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16_S                                  |
| / (P) _U |                                                           | 0 to 65535      | 16-bit unsigned binary | ANY16_U                                  |
| (s2)     | Divisor data or the device where divisor data is stored   | -32768 to 32767 | 16-bit signed binary   | ANY16_S                                  |
| / (P) _U |                                                           | 0 to 65535      | 16-bit unsigned binary | ANY16_U                                  |
| (d)      | Start device for storing the operation result             | —               | 32-bit signed binary   | ANY16_S_ARRAY<br>(Number of elements: 2) |
| / (P) _U |                                                           |                 | 32-bit unsigned binary | ANY16_U_ARRAY<br>(Number of elements: 2) |
| EN       | Execution condition                                       | —               | Bit                    | BOOL                                     |
| ENO      | Execution result                                          | —               | Bit                    | BOOL                                     |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Other s |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|---------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |         |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —       |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —       |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —       |

## Processing details

- These instructions divide the 16-bit binary data in the device specified by (s1) by the 16-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



(d): Quotient

(d)+1: Remainder

- As the operation result, the quotient and remainder are stored in 32 bits. When a bit device is specified, the number of digit-specified bits is used to store the quotient and remainder.
- Quotient...Stored in lower 16 bits.
- Remainder...Stored in upper 16 bits.

## Operation error

| Error code (SD0) | Description                                               |
|------------------|-----------------------------------------------------------|
| 3280H            | The value (divisor) in the device specified by (s2) is 0. |

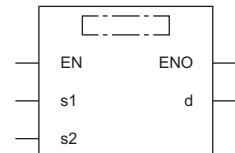
# Multiplying 32-bit binary data

## D\*(P)(\_U)

These instructions multiply the two sets of 32-bit binary data specified.

| Ladder | ST                                                    |                                                           |
|--------|-------------------------------------------------------|-----------------------------------------------------------|
|        | ENO:=DMULTI(EN,s1,s2,d);<br>ENO:=DMULTIP(EN,s1,s2,d); | ENO:=DMULTI_U(EN,s1,s2,d);<br>ENO:=DMULTIP_U(EN,s1,s2,d); |

## FBD/LD



(□ is to be replaced by any of the following: DMULTI, DMULTIP, DMULTI\_U, DMULTIP\_U.)

## Execution condition

| Instruction  | Execution condition |
|--------------|---------------------|
| D*<br>D*_U   |                     |
| D*P<br>D*P_U |                     |

## Setting data

## Description, range, data type

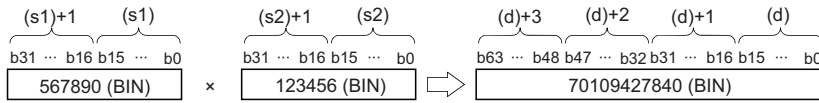
| Operand |         | Description                                                             | Range                     | Data type              | Data type (label)                        |
|---------|---------|-------------------------------------------------------------------------|---------------------------|------------------------|------------------------------------------|
| (s1)    | D*(P)   | Multiplicand data or the start device where multiplicand data is stored | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S                                  |
|         | D*(P)_U |                                                                         | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U                                  |
| (s2)    | D*(P)   | Multiplier data or the start device where multiplier data is stored     | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S                                  |
|         | D*(P)_U |                                                                         | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U                                  |
| (d)     | D*(P)   | Start device for storing the operation result                           | —                         | 64-bit signed binary   | ANY32_S_ARRAY<br>(Number of elements: 2) |
|         | D*(P)_U |                                                                         |                           | 64-bit unsigned binary | ANY32_U_ARRAY<br>(Number of elements: 2) |
| EN      |         | Execution condition                                                     | —                         | Bit                    | BOOL                                     |
| ENO     |         | Execution result                                                        | —                         | Bit                    | BOOL                                     |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions multiply the 32-bit binary data in the device specified by (s1) by the 32-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



- When (d) is a bit device, only the lower 32 bits of the operation result are stored. If the upper 32 bits of the operation result are required, temporarily store the result in a word device, and transfer the data stored in (d)+2 and (d)+3 to the specified bit devices.

### Ex.

Operation result when (d) is a bit device

- K1...Lower 4 bits (b0 to b3)
- K4...Lower 16 bits (b0 to b15)
- K8...Lower 32 bits (b0 to b31)

## Operation error

There is no operation error.

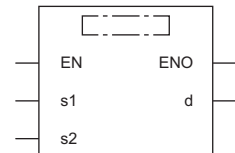
# Dividing 32-bit binary data

## D/(P)(\_U)

These instructions perform division between the two sets of 32-bit binary data specified.

| Ladder | ST                                                          |                                                                 |
|--------|-------------------------------------------------------------|-----------------------------------------------------------------|
|        | ENO:=DDIVISION(EN,s1,s2,d);<br>ENO:=DDIVISIONP(EN,s1,s2,d); | ENO:=DDIVISION_U(EN,s1,s2,d);<br>ENO:=DDIVISIONP_U(EN,s1,s2,d); |

## FBD/LD



(□ is to be replaced by any of the following: DDIVISION, DDIVISIONP, DDIVISION\_U, DDIVISIONP\_U.)

## Execution condition

| Instruction  | Execution condition |
|--------------|---------------------|
| D/<br>D/_U   |                     |
| D/P<br>D/P_U |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                | Range                     | Data type              | Data type (label)                        |
|---------|----------------------------------------------------------------------------|---------------------------|------------------------|------------------------------------------|
| (s1)    | D/(P)<br>Dividend data or the start device where dividend data is stored   | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S                                  |
|         | D/(P)_U<br>Dividend data or the start device where dividend data is stored | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U                                  |
| (s2)    | D/(P)<br>Divisor data or the start device where divisor data is stored     | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S                                  |
|         | D/(P)_U<br>Divisor data or the start device where divisor data is stored   | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U                                  |
| (d)     | D/(P)<br>Start device for storing the operation result                     | —                         | 64-bit signed binary   | ANY32_S_ARRAY<br>(Number of elements: 2) |
|         | D/(P)_U<br>Start device for storing the operation result                   | —                         | 64-bit unsigned binary | ANY32_U_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                        | —                         | Bit                    | BOOL                                     |
| ENO     | Execution result                                                           | —                         | Bit                    | BOOL                                     |

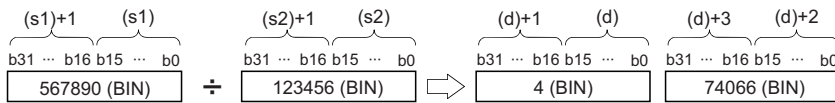
## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |



## Processing details

- These instructions divide the 32-bit binary data in the device specified by (s1) by the 32-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



- As the operation result when a word device is specified, the quotient and remainder are stored in 64 bits. The quotient is stored in lower 32 bits, and the remainder is stored in upper 32 bits. When a bit device is specified, only quotient is stored in 32 bits.

## Operation error

| Error code (SD0) | Description                                               |
|------------------|-----------------------------------------------------------|
| 3280H            | The value (divisor) in the device specified by (s2) is 0. |

# Adding BCD 4-digit data

## B+(P) [when two operands are set]

These instructions add the two sets of BCD 4-digit data specified.

| Ladder | ST                                                               |
|--------|------------------------------------------------------------------|
|        | Not supported<br>( Page 293 B+(P) [when three operands are set]) |

| FBD/LD                                                           |
|------------------------------------------------------------------|
| Not supported<br>( Page 293 B+(P) [when three operands are set]) |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| B+          |                     |
| B+P         |                     |

## Setting data

## Description, range, data type

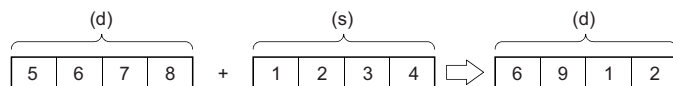
| Operand | Description                                                             | Range     | Data type   | Data type (label) |
|---------|-------------------------------------------------------------------------|-----------|-------------|-------------------|
| (s)     | Second addend data or the device where the second addend data is stored | 0 to 9999 | BCD 4-digit | ANY16             |
| (d)     | Device where the first addend data is stored                            | 0 to 9999 | BCD 4-digit | ANY16             |

## Applicable devices

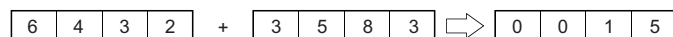
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions add the BCD 4-digit data in the device specified by (d) and the BCD 4-digit data in the device specified by (s), and store the operation result in the device specified by (d).



- If the result exceeds 9999, the carry bit is ignored. In this case, SM700 does not turn on.



## Operation error

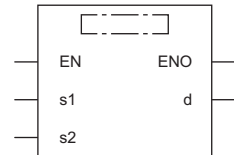
| Error code (SD0) | Description                                                                                                                                                |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | The BCD data in the device specified by (s) is out of the range, 0 to 9999.<br>The BCD data in the device specified by (d) is out of the range, 0 to 9999. |

## B+(P) [when three operands are set]

These instructions add the two sets of BCD 4-digit data specified.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | ENO:=BPLUS(EN,s1,s2,d);<br>ENO:=BPLUSP(EN,s1,s2,d); |

### FBD/LD



( is to be replaced by either of the following: BPLUS, BPLUSP.)

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| B+          |                     |
| B+P         |                     |

### Setting data

### Description, range, data type

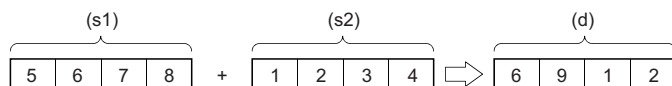
| Operand | Description                                                             | Range     | Data type   | Data type (label) |
|---------|-------------------------------------------------------------------------|-----------|-------------|-------------------|
| (s1)    | First addend data or the device where the first addend data is stored   | 0 to 9999 | BCD 4-digit | ANY16             |
| (s2)    | Second addend data or the device where the second addend data is stored | 0 to 9999 | BCD 4-digit | ANY16             |
| (d)     | Device for storing the operation result                                 | —         | BCD 4-digit | ANY16             |
| EN      | Execution condition                                                     | —         | Bit         | BOOL              |
| ENO     | Execution result                                                        | —         | Bit         | BOOL              |

### Applicable devices

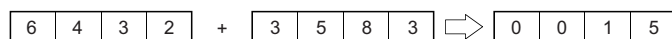
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions add the BCD 4-digit data in the device specified by (s1) and the BCD 4-digit data in the device specified by (s2), and store the operation result in the device specified by (d).



- If the result exceeds 9999, the carry bit is ignored. In this case, SM700 does not turn on.



## Operation error

| Error code<br>(SD0) | Description                                                                  |
|---------------------|------------------------------------------------------------------------------|
| 3285H               | The BCD data in the device specified by (s1) is out of the range, 0 to 9999. |
|                     | The BCD data in the device specified by (s2) is out of the range, 0 to 9999. |

# Subtracting BCD 4-digit data

12

## B-(P) [when two operands are set]

These instructions perform subtraction between the two sets of BCD 4-digit data specified.

| Ladder | ST                                                                |
|--------|-------------------------------------------------------------------|
|        | Not supported<br>(☞ Page 296 B-(P) [when three operands are set]) |

| FBD/LD                                                            |
|-------------------------------------------------------------------|
| Not supported<br>(☞ Page 296 B-(P) [when three operands are set]) |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| B-          |                     |
| B-P         |                     |

## Setting data

## Description, range, data type

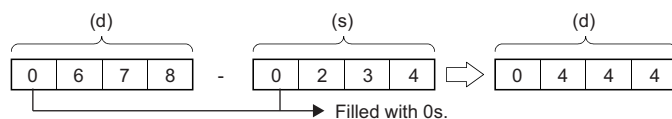
| Operand | Description                                                   | Range     | Data type   | Data type (label) |
|---------|---------------------------------------------------------------|-----------|-------------|-------------------|
| (s)     | Subtrahend data or the device where subtrahend data is stored | 0 to 9999 | BCD 4-digit | ANY16             |
| (d)     | Device where minuend data is stored                           | 0 to 9999 | BCD 4-digit | ANY16             |

## Applicable devices

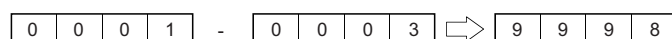
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions subtract the BCD 4-digit data in the device specified by (s) from the 32-bit binary data in the device specified by (d), and store the operation result in the device specified by (d).



- If an underflow occurs, the result will be as follows. In this case, SM700 does not turn on.



## Operation error

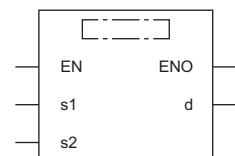
| Error code (SD0) | Description                                                                                                                                                |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | The BCD data in the device specified by (s) is out of the range, 0 to 9999.<br>The BCD data in the device specified by (d) is out of the range, 0 to 9999. |

## B-(P) [when three operands are set]

These instructions perform subtraction between the two sets of BCD 4-digit data specified.

| Ladder | ST                                                    |
|--------|-------------------------------------------------------|
|        | ENO:=BMINUS(EN,s1,s2,d);<br>ENO:=BMINUSP(EN,s1,s2,d); |

### FBD/LD



( $\square$  is to be replaced by either of the following: BMINUS, BMINUSP.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| B-          |                     |
| B-P         |                     |

## Setting data

## Description, range, data type

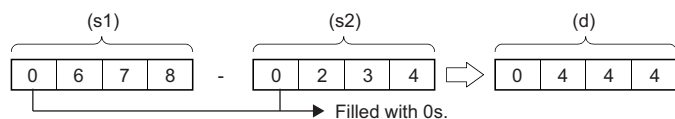
| Operand | Description                                                   | Range     | Data type   | Data type (label) |
|---------|---------------------------------------------------------------|-----------|-------------|-------------------|
| (s1)    | Minuend data or the device where minuend data is stored       | 0 to 9999 | BCD 4-digit | ANY16             |
| (s2)    | Subtrahend data or the device where subtrahend data is stored | 0 to 9999 | BCD 4-digit | ANY16             |
| (d)     | Device for storing the operation result                       | —         | BCD 4-digit | ANY16             |
| EN      | Execution condition                                           | —         | Bit         | BOOL              |
| ENO     | Execution result                                              | —         | Bit         | BOOL              |

## Applicable devices

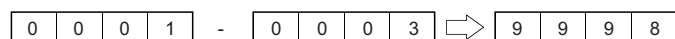
| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions subtract the BCD 4-digit data in the device specified by (s2) from the BCD 4-digit data in the device specified by (s1), and store the operation result in the device specified by (d).



- If an underflow occurs, the result will be as follows. In this case, SM700 does not turn on.



## Operation error

12

| Error code<br>(SD0) | Description                                                                  |
|---------------------|------------------------------------------------------------------------------|
| 3285H               | The BCD data in the device specified by (s1) is out of the range, 0 to 9999. |
|                     | The BCD data in the device specified by (s2) is out of the range, 0 to 9999. |

# Adding BCD 8-digit data

## DB+(P) [when two operands are set]

These instructions add the two sets of BCD 8-digit data specified.

| Ladder                                                            | ST                                                                |
|-------------------------------------------------------------------|-------------------------------------------------------------------|
|                                                                   | Not supported<br>( Page 299 DB+(P) [when three operands are set]) |
| FBD/LD                                                            |                                                                   |
| Not supported<br>( Page 299 DB+(P) [when three operands are set]) |                                                                   |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DB+         |                     |
| DB+P        |                     |

## Setting data

## Description, range, data type

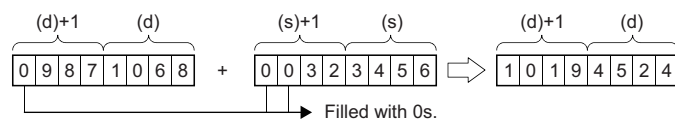
| Operand | Description                                                                   | Range         | Data type   | Data type (label) |
|---------|-------------------------------------------------------------------------------|---------------|-------------|-------------------|
| (s)     | Second addend data or the start device where the second addend data is stored | 0 to 99999999 | BCD 8-digit | ANY32             |
| (d)     | Start device where the first addend data is stored                            | 0 to 99999999 | BCD 8-digit | ANY32             |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

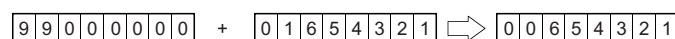
## Processing details

- These instructions add the BCD 8-digit data in the device specified by (d) and the BCD 8-digit data in the device specified by (s), and store the operation result in the device specified by (d).



(d)+1, (s)+1: Upper 4 digits  
 (d), (s): Lower 4 digits

- If the result exceeds 99999999, the carry bit is ignored. In this case, SM700 does not turn on.



## Operation error

| Error code (SD0) | Description                                                                     |
|------------------|---------------------------------------------------------------------------------|
| 3285H            | The BCD data in the device specified by (s) is out of the range, 0 to 99999999. |
|                  | The BCD data in the device specified by (d) is out of the range, 0 to 99999999. |



## DB+(P) [when three operands are set]

These instructions add the two sets of BCD 8-digit data specified.

| Ladder | ST                                                            |
|--------|---------------------------------------------------------------|
|        | <pre>ENO:=DBPLUS(EN,s1,s2,d); ENO:=DBPLUSP(EN,s1,s2,d);</pre> |

| FBD/LD |
|--------|
|        |

(□ is to be replaced by either of the following: DBPLUS, DBPLUSP.)

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DB+         |                     |
| DB+P        |                     |

### Setting data

### Description, range, data type

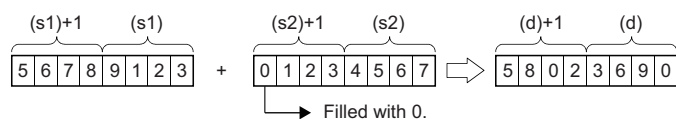
| Operand | Description                                                                   | Range         | Data type   | Data type (label) |
|---------|-------------------------------------------------------------------------------|---------------|-------------|-------------------|
| (s1)    | First addend data or the start device where the first addend data is stored   | 0 to 99999999 | BCD 8-digit | ANY32             |
| (s2)    | Second addend data or the start device where the second addend data is stored | 0 to 99999999 | BCD 8-digit | ANY32             |
| (d)     | Start device for storing the operation result                                 | —             | BCD 8-digit | ANY32             |
| EN      | Execution condition                                                           | —             | Bit         | BOOL              |
| ENO     | Execution result                                                              | —             | Bit         | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   |             | Double word |      | Indirect specification | Constant |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|-------------|------|------------------------|----------|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |        |
| (s1)    | ○                                | ○   | ○                                     | ○           | ○ | ○           | ○           | ○    | ○                      | ○        | —  | — | —      |
| (s2)    | ○                                | ○   | ○                                     | ○           | ○ | ○           | ○           | ○    | ○                      | ○        | —  | — | —      |
| (d)     | ○                                | ○   | ○                                     | ○           | ○ | ○           | ○           | ○    | ○                      | —        | —  | — | —      |

### Processing details

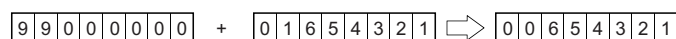
- These instructions add the BCD 8-digit data in the device specified by (s1) and the BCD 8-digit data in the device specified by (s2), and store the operation result in the device specified by (d).



(d)+1, (s1)+1, (s2)+1: Upper 4 digits

(d), (s1), (s2): Lower 4 digits

- If the result exceeds 99999999, the carry bit is ignored. In this case, SM700 does not turn on.



## Operation error

| Error code<br>(SD0) | Description                                                                      |
|---------------------|----------------------------------------------------------------------------------|
| 3285H               | The BCD data in the device specified by (s1) is out of the range, 0 to 99999999. |
|                     | The BCD data in the device specified by (s2) is out of the range, 0 to 99999999. |

# Subtracting BCD 8-digit data

## DB-(P) [when two operands are set]

These instructions perform subtraction between the two sets of BCD 8-digit data specified.

| Ladder                                                            | ST                                                                |
|-------------------------------------------------------------------|-------------------------------------------------------------------|
|                                                                   | Not supported<br>( Page 303 DB-(P) [when three operands are set]) |
| FBD/LD                                                            |                                                                   |
| Not supported<br>( Page 303 DB-(P) [when three operands are set]) |                                                                   |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DB-         |                     |
| DB-P        |                     |

## Setting data

## Description, range, data type

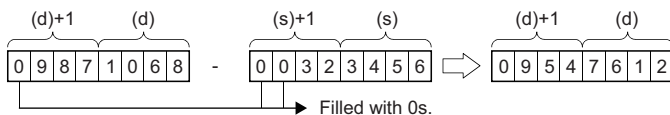
| Operand | Description                                                         | Range         | Data type   | Data type (label) |
|---------|---------------------------------------------------------------------|---------------|-------------|-------------------|
| (s)     | Subtrahend data or the start device where subtrahend data is stored | 0 to 99999999 | BCD 8-digit | ANY32             |
| (d)     | Minuend data or the start device where minuend data is stored       | 0 to 99999999 | BCD 8-digit | ANY32             |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

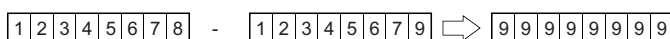
- These instructions subtract the BCD 8-digit data in the device specified by (s) from the BCD 8-digit data in the device specified by (d), and store the operation result in the device specified by (d).



(d)+1, (s)+1: Upper 4 digits

(d), (s): Lower 4 digits

- If an underflow occurs, the result will be as follows. In this case, SM700 does not turn on.



## Operation error

| Error code (SD0) | Description                                                                     |
|------------------|---------------------------------------------------------------------------------|
| 3285H            | The BCD data in the device specified by (s) is out of the range, 0 to 99999999. |
|                  | The BCD data in the device specified by (d) is out of the range, 0 to 99999999. |

## DB-(P) [when three operands are set]

These instructions perform subtraction between the two sets of BCD 8-digit data specified.

| Ladder | ST                                                      |
|--------|---------------------------------------------------------|
|        | ENO:=DBMINUS(EN,s1,s2,d);<br>ENO:=DBMINUSP(EN,s1,s2,d); |

| FBD/LD |
|--------|
|        |

(□ is to be replaced by either of the following: DBMINUS, DBMINUSP.)

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DB-         |                     |
| DB-P        |                     |

### Setting data

### Description, range, data type

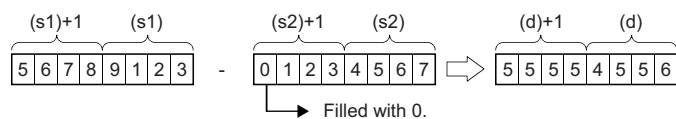
| Operand | Description                                                         | Range         | Data type   | Data type (label) |
|---------|---------------------------------------------------------------------|---------------|-------------|-------------------|
| (s1)    | Minuend data or the start device where minuend data is stored       | 0 to 99999999 | BCD 8-digit | ANY32             |
| (s2)    | Subtrahend data or the start device where subtrahend data is stored | 0 to 99999999 | BCD 8-digit | ANY32             |
| (d)     | Start device for storing the operation result                       | —             | BCD 8-digit | ANY32             |
| EN      | Execution condition                                                 | —             | Bit         | BOOL              |
| ENO     | Execution result                                                    | —             | Bit         | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |              | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|--------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○            | ○           | ○           | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○            | ○           | ○           | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○            | ○           | ○           | ○                      | —        | — | —  | —      |

### Processing details

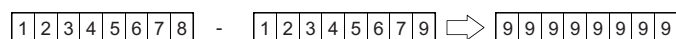
- These instructions subtract the BCD 8-digit data in the device specified by (s2) from the BCD 8-digit data in the device specified by (s1), and store the operation result in the device specified by (d).



(d)+1, (s1)+1, (s2)+1: Upper 4 digits

(d), (s1), (s2): Lower 4 digits

- If an underflow occurs, the result will be as follows. In this case, SM700 does not turn on.



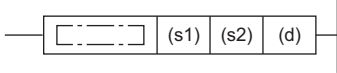
## Operation error

| Error code<br>(SD0) | Description                                                                      |
|---------------------|----------------------------------------------------------------------------------|
| 3285H               | The BCD data in the device specified by (s1) is out of the range, 0 to 99999999. |
|                     | The BCD data in the device specified by (s2) is out of the range, 0 to 99999999. |

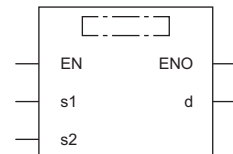
# Multiplying BCD 4-digit data

## B\*(P)

These instructions multiply the two sets of BCD 4-digit data specified.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

## FBD/LD



(□ is to be replaced by either of the following: BMULTI, BMULTIP.)

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| B*          |  |
| B*P         |  |

## Setting data

## Description, range, data type

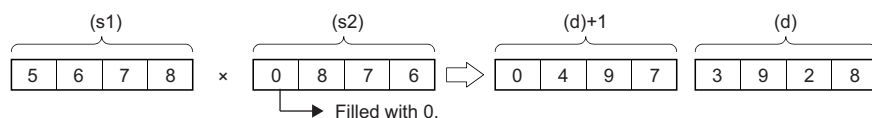
| Operand | Description                                                       | Range     | Data type   | Data type (label) |
|---------|-------------------------------------------------------------------|-----------|-------------|-------------------|
| (s1)    | Multiplicand data or the device where multiplicand data is stored | 0 to 9999 | BCD 4-digit | ANY16             |
| (s2)    | Multiplier data or the device where multiplier data is stored     | 0 to 9999 | BCD 4-digit | ANY16             |
| (d)     | Start device for storing the operation result                     | —         | BCD 8-digit | ANY32             |
| EN      | Execution condition                                               | —         | Bit         | BOOL              |
| ENO     | Execution result                                                  | —         | Bit         | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

These instructions multiply the BCD 4-digit data in the device specified by (s1) by the BCD 4-digit data in the device specified by (s2), and store the operation result in the device specified by (d). ((d)+1: Upper 4 digits, (d): Lower 4 digits)



## Operation error

| Error code<br>(SD0) | Description                                                                  |
|---------------------|------------------------------------------------------------------------------|
| 3285H               | The BCD data in the device specified by (s1) is out of the range, 0 to 9999. |
|                     | The BCD data in the device specified by (s2) is out of the range, 0 to 9999. |



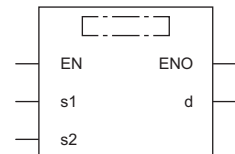
## Dividing BCD 4-digit data

### B/(P)

These instructions perform division between the two sets of BCD 4-digit data specified.

| Ladder | ST            |
|--------|---------------|
|        | Not supported |

### FBD/LD



(□ is to be replaced by either of the following: BDIVISION, BDIVISIONP.)

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| B/          |                     |
| B/P         |                     |

### Setting data

### ■Description, range, data type

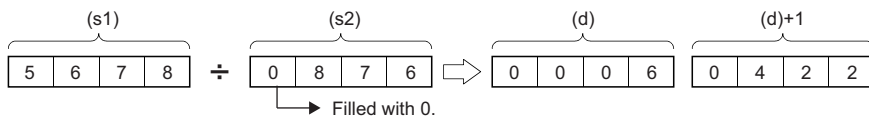
| Operand | Description                                               | Range     | Data type   | Data type (label)                      |
|---------|-----------------------------------------------------------|-----------|-------------|----------------------------------------|
| (s1)    | Dividend data or the device where dividend data is stored | 0 to 9999 | BCD 4-digit | ANY16                                  |
| (s2)    | Divisor data or the device where divisor data is stored   | 0 to 9999 | BCD 4-digit | ANY16                                  |
| (d)     | Start device for storing the operation result             | —         | BCD 8-digit | ANY16_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                       | —         | Bit         | BOOL                                   |
| ENO     | Execution result                                          | —         | Bit         | BOOL                                   |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K        | H | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | — | —  | —      |

## Processing details

- These instructions divide the BCD 4-digit data in the device specified by (s1) by the BCD 4-digit data in the device specified by (s2), and store the operation result in the device specified by (d).



(d): Quotient

(d)+1: Remainder

- As the operation result, the quotient and remainder are stored in 32 bits.
- Quotient (BCD 4 digits)---Stored in lower 16 bits.
- Remainder (BCD 4 digits)---Stored in upper 16 bits.

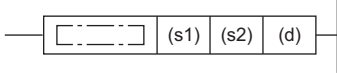
## Operation error

| Error code (SD0) | Description                                                                  |
|------------------|------------------------------------------------------------------------------|
| 3280H            | The value (divisor) in the device specified by (s2) is 0.                    |
| 3285H            | The BCD data in the device specified by (s1) is out of the range, 0 to 9999. |
|                  | The BCD data in the device specified by (s2) is out of the range, 0 to 9999. |

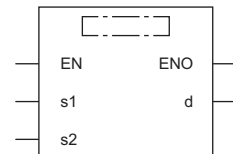
# Multiplying BCD 8-digit data

## DB\*(P)

These instructions multiply the two sets of BCD 8-digit data specified.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

## FBD/LD



(□ is to be replaced by either of the following: DBMULTI, DBMULTIP.)

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DB*         |  |
| DB*P        |  |

## Setting data

## Description, range, data type

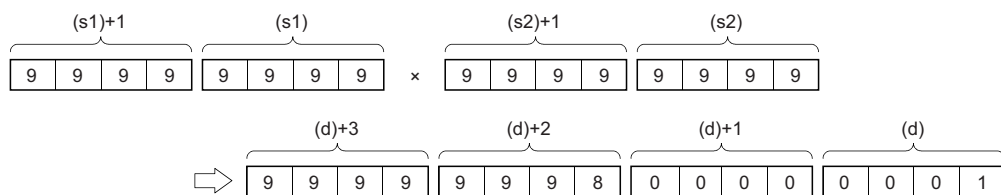
| Operand | Description                                                             | Range         | Data type    | Data type (label)                      |
|---------|-------------------------------------------------------------------------|---------------|--------------|----------------------------------------|
| (s1)    | Multiplicand data or the start device where multiplicand data is stored | 0 to 99999999 | BCD 8-digit  | ANY32                                  |
| (s2)    | Multiplier data or the start device where multiplier data is stored     | 0 to 99999999 | BCD 8-digit  | ANY32                                  |
| (d)     | Start device for storing the operation result                           | —             | BCD 16-digit | ANY32_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                     | —             | Bit          | BOOL                                   |
| ENO     | Execution result                                                        | —             | Bit          | BOOL                                   |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions multiply the BCD 8-digit data in the device specified by (s1) by the BCD 8-digit data in the device specified by (s2), and store the operation result in the device specified by (d).



- When (d) is a bit device, only the lower 8 digits (lower 32 bits) of the operation result are stored.

### Ex.

Operation result when (d) is a bit device

- K1...Lower 1 digit (b0 to b3)
- K4...Lower 4 digits (b0 to b15)
- K8...Lower 8 digits (b0 to b31)

## Operation error

| Error code (SD0) | Description                                                                      |
|------------------|----------------------------------------------------------------------------------|
| 3285H            | The BCD data in the device specified by (s1) is out of the range, 0 to 99999999. |
|                  | The BCD data in the device specified by (s2) is out of the range, 0 to 99999999. |

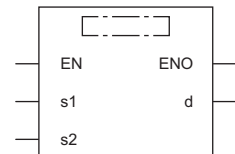
## Dividing BCD 8-digit data

### DB/(P)

These instructions perform division between the two sets of BCD 8-digit data specified.

| Ladder | ST            |
|--------|---------------|
|        | Not supported |

### FBD/LD



(□ is to be replaced by either of the following: DBDIVISION, DBDIVISIONP.)

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DB/         |                     |
| DB/P        |                     |

### Setting data

### ■Description, range, data type

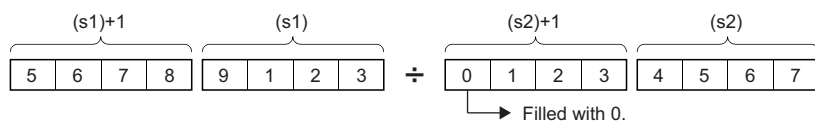
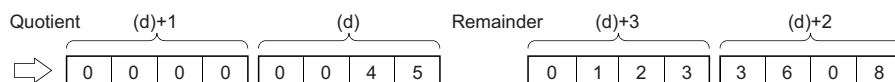
| Operand | Description                                                     | Range         | Data type    | Data type (label)                      |
|---------|-----------------------------------------------------------------|---------------|--------------|----------------------------------------|
| (s1)    | Dividend data or the start device where dividend data is stored | 0 to 99999999 | BCD 8-digit  | ANY32                                  |
| (s2)    | Divisor data or the start device where divisor data is stored   | 0 to 99999999 | BCD 8-digit  | ANY32                                  |
| (d)     | Start device for storing the operation result                   | —             | BCD 16-digit | ANY32_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                             | —             | Bit          | BOOL                                   |
| ENO     | Execution result                                                | —             | Bit          | BOOL                                   |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | —    | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions divide the BCD 8-digit data in the device specified by (s1) by the BCD 8-digit data in the device specified by (s2), and store the operation result in the device specified by (d).



(d)+1, (d)+3: Upper 4 digits

(d), (d)+2: Lower 4 digits

- As the operation result, the quotient and remainder are stored in 64 bits.
  - Quotient (BCD 8 digits)---Stored in lower 32 bits.
  - Remainder (BCD 8 digits)---Stored in upper 32 bits.
- When (d) is a bit device, the remainder is not stored.

## Operation error

| Error code (SD0) | Description                                                                      |
|------------------|----------------------------------------------------------------------------------|
| 3280H            | The value (divisor) in the device specified by (s2) is 0.                        |
| 3285H            | The BCD data in the device specified by (s1) is out of the range, 0 to 99999999. |
|                  | The BCD data in the device specified by (s2) is out of the range, 0 to 99999999. |

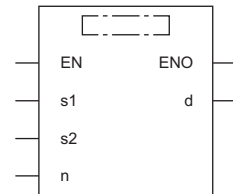
## Adding 16-bit binary block data

### BK+(P)(\_U)

These instructions add the two 16-bit binary data blocks specified.

| Ladder | ST                                                        |                                                               |
|--------|-----------------------------------------------------------|---------------------------------------------------------------|
|        | ENO:=BKPLUS(EN,s1,s2,n,d);<br>ENO:=BKPLUSP(EN,s1,s2,n,d); | ENO:=BKPLUS_U(EN,s1,s2,n,d);<br>ENO:=BKPLUSP_U(EN,s1,s2,n,d); |

### FBD/LD



(□ is to be replaced by any of the following: BKPLUS, BKPLUSP, BKPLUS\_U, BKPLUSP\_U.)

### ■Execution condition

| Instruction    | Execution condition |
|----------------|---------------------|
| BK+<br>BK+_U   |                     |
| BK+P<br>BK+P_U |                     |

### Setting data

### ■Description, range, data type

| Operand     | Description                                                                   | Range           | Data type              | Data type (label)     |
|-------------|-------------------------------------------------------------------------------|-----------------|------------------------|-----------------------|
| (s1) BK+(P) | First addend data or the start device where the first addend data is stored   | -32768 to 32767 | 16-bit signed binary   | ANY16_S <sup>*1</sup> |
| BK+(P)_U    |                                                                               | 0 to 65535      | 16-bit unsigned binary | ANY16_U <sup>*1</sup> |
| (s2) BK+(P) | Second addend data or the start device where the second addend data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16_S <sup>*1</sup> |
| BK+(P)_U    |                                                                               | 0 to 65535      | 16-bit unsigned binary | ANY16_U <sup>*1</sup> |
| (d) BK+(P)  | Start device for storing the operation result                                 | —               | 16-bit signed binary   | ANY16_S <sup>*1</sup> |
| BK+(P)_U    |                                                                               |                 | 16-bit unsigned binary | ANY16_U <sup>*1</sup> |
| (n)         | Number of data points                                                         | 0 to 65535      | 16-bit unsigned binary | ANY16                 |
| EN          | Execution condition                                                           | —               | Bit                    | BOOL                  |
| ENO         | Execution result                                                              | —               | Bit                    | BOOL                  |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

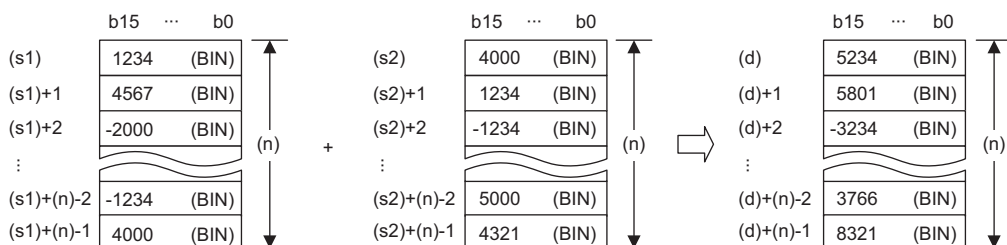
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

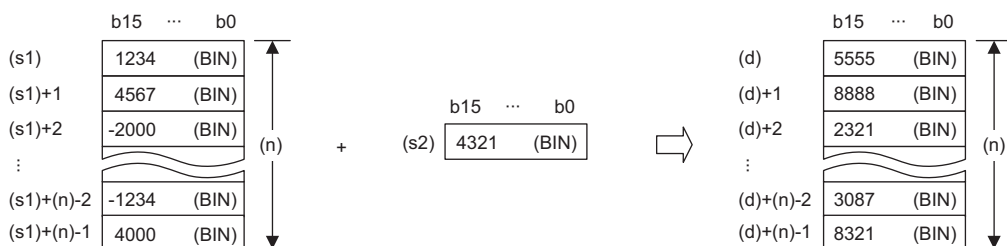
- These instructions add the (n) points of 16-bit binary data from the device specified by (s1) and the (n) points of 16-bit binary data from the device specified by (s2) or the constant, and store the operation result in the device specified by (d) and later.
- Specify data in units of 16 bits.

**Ex.**

When a device is specified by (s2) (signed value specification)



When a constant is specified by (s2) (signed value specification)



- If an overflow occurs, the result will be as follows. In this case, SM700 does not turn on.

| When a signed value is specified |   |                | When an unsigned value is specified |                    |  |
|----------------------------------|---|----------------|-------------------------------------|--------------------|--|
| K32767<br>(H7FFF)                | + | K2<br>(H0002)  | ⇒                                   | K-32767<br>(H8001) |  |
| K-32767<br>(H8001)               | + | K-2<br>(HFFFE) | ⇒                                   | K32767<br>(H7FFF)  |  |
| K65535<br>(HFFFF)                | + | K1<br>(H0001)  | ⇒                                   | K0<br>(H0000)      |  |

## Operation error

| Error code<br>(SD0) | Description                                                                                                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H               | The device ranges starting from the ones specified by (s1) and (d) are overlapping (except when the same device is specified for (s1) and (d)). |
|                     | The device ranges starting from the ones specified by (s2) and (d) are overlapping (except when the same device is specified for (s2) and (d)). |



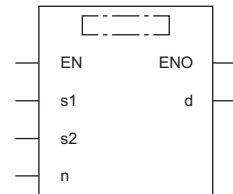
# Subtracting 16-bit binary block data

## BK-(P)(\_U)

These instructions perform subtraction between the two 16-bit binary data blocks specified.

| Ladder | ST                                                          |                                                                 |
|--------|-------------------------------------------------------------|-----------------------------------------------------------------|
|        | ENO:=BKMINUS(EN,s1,s2,n,d);<br>ENO:=BKMINUSP(EN,s1,s2,n,d); | ENO:=BKMINUS_U(EN,s1,s2,n,d);<br>ENO:=BKMINUSP_U(EN,s1,s2,n,d); |

### FBD/LD



(□ is to be replaced by any of the following: BKMINUS, BKMINUSP, BKMINUS\_U, BKMINUSP\_U.)

### Execution condition

| Instruction    | Execution condition |
|----------------|---------------------|
| BK-<br>BK_U    |                     |
| BK-P<br>BK-P_U |                     |

### Setting data

#### Description, range, data type

| Operand                 | Description                                                         | Range                         | Data type                                      | Data type (label)                              |
|-------------------------|---------------------------------------------------------------------|-------------------------------|------------------------------------------------|------------------------------------------------|
| (s1) BK-(P)<br>BK-(P)_U | Minuend data or the start device where minuend data is stored       | -32768 to 32767<br>0 to 65535 | 16-bit signed binary<br>16-bit unsigned binary | ANY16_S <sup>*1</sup><br>ANY16_U <sup>*1</sup> |
| (s2) BK-(P)<br>BK-(P)_U | Subtrahend data or the start device where subtrahend data is stored | -32768 to 32767<br>0 to 65535 | 16-bit signed binary<br>16-bit unsigned binary | ANY16_S <sup>*1</sup><br>ANY16_U <sup>*1</sup> |
| (d) BK-(P)<br>BK-(P)_U  | Start device for storing the operation result                       | —                             | 16-bit signed binary<br>16-bit unsigned binary | ANY16_S <sup>*1</sup><br>ANY16_U <sup>*1</sup> |
| (n)                     | Number of data points                                               | 0 to 65535                    | 16-bit unsigned binary                         | ANY16                                          |
| EN                      | Execution condition                                                 | —                             | Bit                                            | BOOL                                           |
| ENO                     | Execution result                                                    | —                             | Bit                                            | BOOL                                           |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

#### Applicable devices

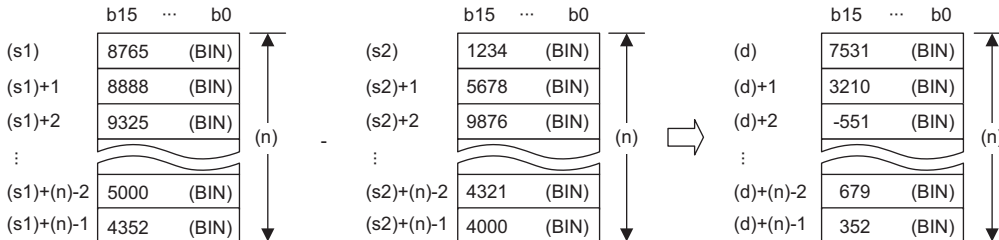
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

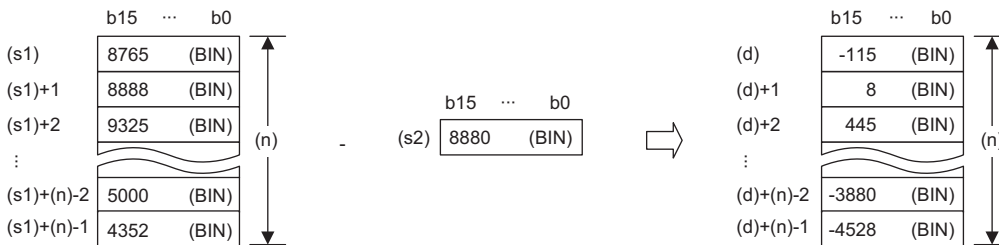
- These instructions subtract the (n) points of 16-bit binary data from the device specified by (s2) or the constant from the (n) points of 16-bit binary data from the device specified by (s1), and store the operation result in the device specified by (d) and later.
- Specify data in units of 16 bits.

### Ex.

When a device is specified by (s2)



When a constant is specified by (s2)



- If an overflow occurs, the result will be as follows. In this case, SM700 does not turn on.

| When a signed value is specified |   |                | When an unsigned value is specified |                    |                                     |
|----------------------------------|---|----------------|-------------------------------------|--------------------|-------------------------------------|
| K-32768<br>(H8000)               | - | K2<br>(H0002)  | ⇒                                   | K32766<br>(H7FFE)  |                                     |
| K32767<br>(H7FFF)                | - | K-2<br>(HFFFE) | ⇒                                   | K-32767<br>(H8001) |                                     |
|                                  |   |                |                                     | K0<br>(H0000)      | - K1<br>(H0001) ⇒ K65535<br>(HFFFF) |

## Operation error

| Error code<br>(SD0) | Description                                                                                                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H               | The device ranges starting from the ones specified by (s1) and (d) are overlapping (except when the same device is specified for (s1) and (d)). |
|                     | The device ranges starting from the ones specified by (s2) and (d) are overlapping (except when the same device is specified for (s2) and (d)). |

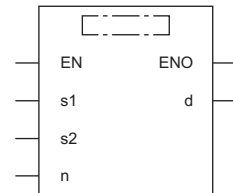
## Adding 32-bit binary block data

### DBK+(P)(\_U)

These instructions add the two 32-bit binary data blocks specified.

| Ladder | ST                                                          |                                                                 |
|--------|-------------------------------------------------------------|-----------------------------------------------------------------|
|        | ENO:=DBKPLUS(EN,s1,s2,n,d);<br>ENO:=DBKPLUSP(EN,s1,s2,n,d); | ENO:=DBKPLUS_U(EN,s1,s2,n,d);<br>ENO:=DBKPLUSP_U(EN,s1,s2,n,d); |

### FBD/LD



(□ is to be replaced by any of the following: DBKPLUS, DBKPLUSP, DBKPLUS\_U, DBKPLUSP\_U.)

### Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| DBK+<br>DBK+_U   |                     |
| DBK+P<br>DBK+P_U |                     |

### Setting data

### Description, range, data type

| Operand |           | Description                                                                   | Range                     | Data type              | Data type (label)     |
|---------|-----------|-------------------------------------------------------------------------------|---------------------------|------------------------|-----------------------|
| (s1)    | DBK+(P)   | First addend data or the start device where the first addend data is stored   | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S <sup>*1</sup> |
|         | DBK+(P)_U |                                                                               | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U <sup>*1</sup> |
| (s2)    | DBK+(P)   | Second addend data or the start device where the second addend data is stored | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S <sup>*1</sup> |
|         | DBK+(P)_U |                                                                               | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U <sup>*1</sup> |
| (d)     | DBK+(P)   | Start device for storing the operation result                                 | —                         | 32-bit signed binary   | ANY32_S <sup>*1</sup> |
|         | DBK+(P)_U |                                                                               |                           | 32-bit unsigned binary | ANY32_U <sup>*1</sup> |
| (n)     |           | Number of data points                                                         | 0 to 65535                | 16-bit unsigned binary | ANY16                 |
| EN      |           | Execution condition                                                           | —                         | Bit                    | BOOL                  |
| ENO     |           | Execution result                                                              | —                         | Bit                    | BOOL                  |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

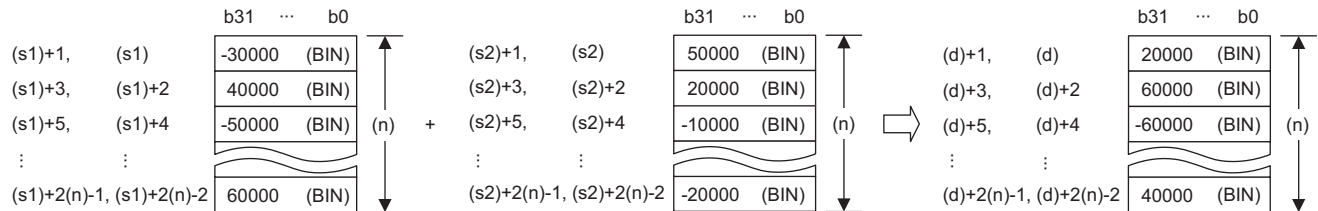
| Operand | Bit                              |      | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

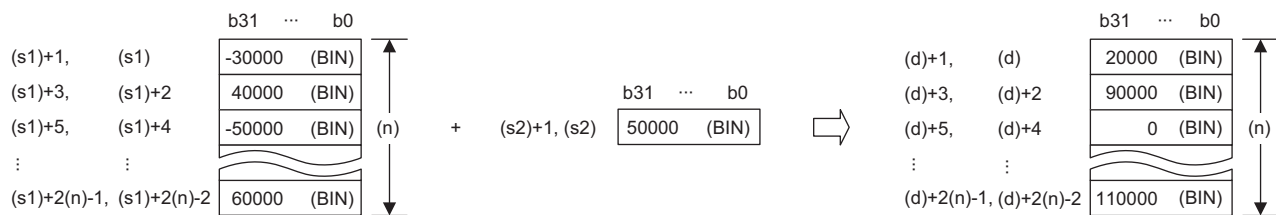
- These instructions add the (n) points of 32-bit binary data from the device specified by (s1) and the (n) points of 32-bit binary data from the device specified by (s2) or the constant, and store the operation result in the device specified by (d) and later.
- Specify data in units of 32 bits.

**Ex.**

When a device is specified by (s2) (signed value specification)



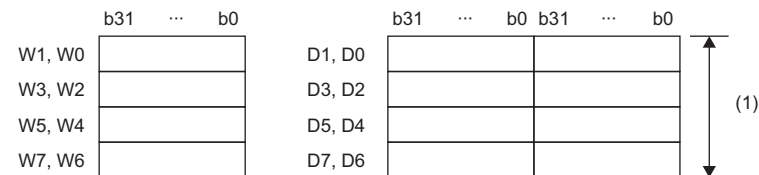
When a constant is specified by (s2) (signed value specification)



- Operation is possible when the same device is specified by (s1) or (s2) and (d). However, if the device range of (n) points from (s1) or (s2) and the device range of (n) points from (d) are partly overlapped, an error results.

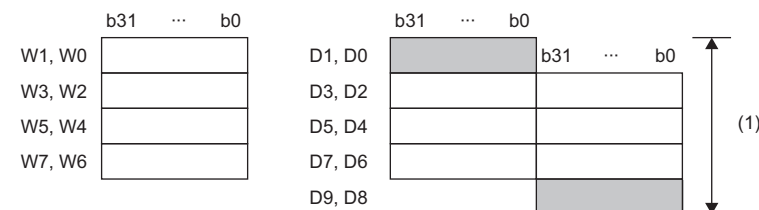
**Ex.**

When the four points of device from that specified by (s2) and (d) exactly match



(1) Operation is possible because they exactly match.

When four points of device from that specified by (s2) and (d) are partly overlapped



(1) An operation error results because they partly match.

- If (n) is 0, no processing is performed.
- If an overflow occurs, the result will be as follows. In this case, SM700 does not turn on.

| When a signed value is specified                                                                                                            | When an unsigned value is specified                      |
|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| K2147483647 (H7FFFFFFF) + K2 (H00000002) → K-2147483647 (H80000001)<br>K-2147483647 (H80000001) + K-2 (HFFFFFFFE) → K2147483647 (H7FFFFFFF) | K4294967295 (HFFFFFFF) + K1 (H00000001) → K0 (H00000000) |

| Error code (SD0) | Description                                                                                                                                     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The device ranges starting from the ones specified by (s1) and (d) are overlapping (except when the same device is specified for (s1) and (d)). |
|                  | The device ranges starting from the ones specified by (s2) and (d) are overlapping (except when the same device is specified for (s2) and (d)). |

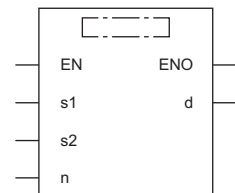
# Subtracting 32-bit binary block data

## DBK-(P)(\_U)

These instructions perform subtraction between the two 32-bit binary data blocks specified.

| Ladder | ST                                                            |                                                                   |
|--------|---------------------------------------------------------------|-------------------------------------------------------------------|
|        | ENO:=DBKMINUS(EN,s1,s2,n,d);<br>ENO:=DBKMINUSP(EN,s1,s2,n,d); | ENO:=DBKMINUS_U(EN,s1,s2,n,d);<br>ENO:=DBKMINUSP_U(EN,s1,s2,n,d); |

## FBD/LD



(□ is to be replaced by any of the following: DBKMINUS, DBKMINUSP, DBKMINUS\_U, DBKMINUSP\_U.)

## Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| DBK-<br>DBK-_U   |                     |
| DBK-P<br>DBK-P_U |                     |

## Setting data

## Description, range, data type

| Operand |           | Description                                                         | Range                     | Data type              | Data type (label)     |
|---------|-----------|---------------------------------------------------------------------|---------------------------|------------------------|-----------------------|
| (s1)    | DBK-(P)   | Minuend data or the start device where minuend data is stored       | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S <sup>*1</sup> |
|         | DBK-(P)_U |                                                                     | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U <sup>*1</sup> |
| (s2)    | DBK-(P)   | Subtrahend data or the start device where subtrahend data is stored | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S <sup>*1</sup> |
|         | DBK-(P)_U |                                                                     | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U <sup>*1</sup> |
| (d)     | DBK-(P)   | Start device for storing the operation result                       | —                         | 32-bit signed binary   | ANY32_S <sup>*1</sup> |
|         | DBK-(P)_U |                                                                     |                           | 32-bit unsigned binary | ANY32_U <sup>*1</sup> |
| (n)     |           | Number of data points                                               | 0 to 65535                | 16-bit unsigned binary | ANY16                 |
| EN      |           | Execution condition                                                 | —                         | Bit                    | BOOL                  |
| ENO     |           | Execution result                                                    | —                         | Bit                    | BOOL                  |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

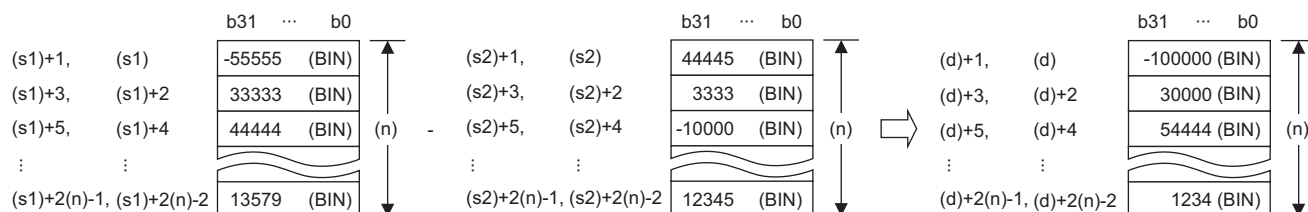
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

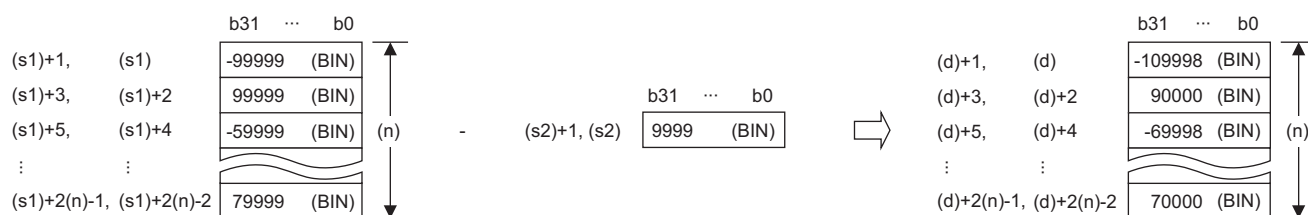
- These instructions subtract the (n) points of 32-bit binary data from the device specified by (s2) or the constant from the (n) points of 32-bit binary data from the device specified by (s1), and store the operation result in the device specified by (d) and later.
- Specify data in units of 32 bits.

### Ex.

When a device is specified by (s2) (signed value specification)



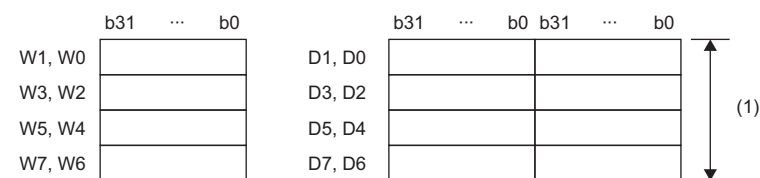
When a constant is specified by (s2) (signed value specification)



- Operation is possible when the same device is specified by (s1) or (s2) and (d). However, if the device range of (n) points from (s1) or (s2) and the device range of (n) points from (d) are partly overlapped, an error results.

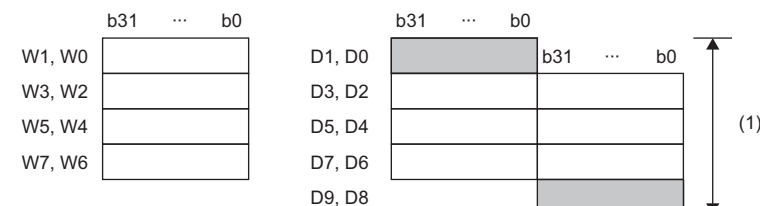
### Ex.

When the four points of device from that specified by (s2) and (d) exactly match



(1) Operation is possible because they exactly match.

When four points of device from that specified by (s2) and (d) are partly overlapped



(1) An operation error results because they partly match.

- If (n) is 0, no processing is performed.
- If an overflow occurs, the result will be as follows. In this case, SM700 does not turn on.

| When a signed value is specified |   | When an unsigned value is specified |                               |
|----------------------------------|---|-------------------------------------|-------------------------------|
| K2147483647<br>(H7FFFFFFF)       | - | K-2<br>(HFFFFFFFE)                  | → K-2147483647<br>(H80000001) |
| K-2147483647<br>(H80000001)      | - | K2<br>(H00000002)                   | → K2147483647<br>(H7FFFFFFF)  |
|                                  |   | K0<br>(H00000000)                   | -                             |
|                                  |   | K1<br>(H00000001)                   | → K4294967295<br>(HFFFFFFF)   |

## Operation error

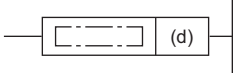
| Error code<br>(SD0) | Description                                                                                                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H               | The device ranges starting from the ones specified by (s1) and (d) are overlapping (except when the same device is specified for (s1) and (d)). |
|                     | The device ranges starting from the ones specified by (s2) and (d) are overlapping (except when the same device is specified for (s2) and (d)). |

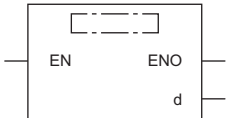


# Incrementing 16-bit binary data

## INC(P)(\_U)

These instructions increment the specified 16-bit binary data by one.

| Ladder                                                                            | ST                                  |                                         |
|-----------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------|
|  | ENO:=INC(EN,d);<br>ENO:=INCP(EN,d); | ENO:=INC_U(EN,d);<br>ENO:=INCP_U(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction    | Execution condition                                                               |
|----------------|-----------------------------------------------------------------------------------|
| INC<br>INC_U   |  |
| INCP<br>INCP_U |  |

### Setting data

### Description, range, data type

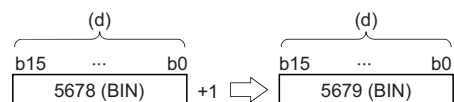
| Operand | Description         | Range           | Data type              | Data type (label) |
|---------|---------------------|-----------------|------------------------|-------------------|
| (d)     | INC(P)              | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | INC(P)_U            | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition | —               | Bit                    | BOOL              |
| ENO     | Execution result    | —               | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions increment the 16-bit binary data in the device specified by (d) by one.



- When the INC(P) instruction is executed while the data in the device specified by (d) is 32767, -32768 is stored in the device specified by (d). (When a signed value is specified)
- When the INC(P)\_U instruction is executed while the data in the device specified by (d) is 65535, 0 is stored in the device specified by (d). (When an unsigned value is specified)

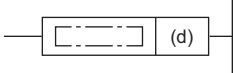
### Operation error

There is no operation error.

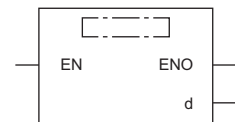
# Decrementing 16-bit binary data

## DEC(P)(\_U)

These instructions decrement the specified 16-bit binary data by one.

| Ladder                                                                            | ST                                  |                                         |
|-----------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------|
|  | ENO:=DEC(EN,d);<br>ENO:=DECP(EN,d); | ENO:=DEC_U(EN,d);<br>ENO:=DECP_U(EN,d); |

## FBD/LD



## Execution condition

| Instruction    | Execution condition                                                               |
|----------------|-----------------------------------------------------------------------------------|
| DEC<br>DEC_U   |  |
| DECP<br>DECP_U |  |

## Setting data

## Description, range, data type

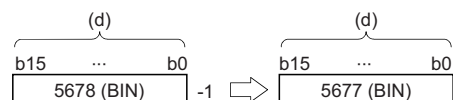
| Operand    | Description             | Range           | Data type              | Data type (label) |
|------------|-------------------------|-----------------|------------------------|-------------------|
| (d) DEC(P) | Decrement target device | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
| DEC(P)_U   |                         | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| EN         | Execution condition     | —               | Bit                    | BOOL              |
| ENO        | Execution result        | —               | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   |             | Double word |      | Indirect specification | Constant |    |   | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|-------------|------|------------------------|----------|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |        |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —           | ○    | —                      | —        | —  | — |        |

## Processing details

- These instructions decrement the 16-bit binary data in the device specified by (d) by one.



- When the DEC(P) instruction is executed while the data in the device specified by (d) is -32768, 32767 is stored in the device specified by (d). (When a signed value is specified)
- When the DEC(P)\_U instruction is executed while the data in the device specified by (d) is 0, 65535 is stored in the device specified by (d). (When an unsigned value is specified)

## Operation error

There is no operation error.

# Incrementing 32-bit binary data

## DINC(P)(\_U)

These instructions increment the specified 32-bit binary data by one.

| Ladder | ST                                    |                                           |
|--------|---------------------------------------|-------------------------------------------|
|        | ENO:=DINC(EN,d);<br>ENO:=DINCP(EN,d); | ENO:=DINC_U(EN,d);<br>ENO:=DINCP_U(EN,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| DINC<br>DINC_U   |                     |
| DINCP<br>DINCP_U |                     |

### Setting data

### Description, range, data type

| Operand   | Description                   | Range                     | Data type              | Data type (label) |
|-----------|-------------------------------|---------------------------|------------------------|-------------------|
| (d)       | Increment target start device | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
| DINC(P)_U |                               | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| EN        | Execution condition           | —                         | Bit                    | BOOL              |
| ENO       | Execution result              | —                         | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions increment the 32-bit binary data in the device specified by (d) by one.



- When the DINC(P)(\_U) instruction is executed while the data in the device specified by (d) is 2147483647, -2147483648 is stored in the device specified by (d). (When a signed value is specified)
- When the DINC(P)(\_U) instruction is executed while the data in the device specified by (d) is 4294967295, 0 is stored in the device specified by (d). (When an unsigned value is specified)

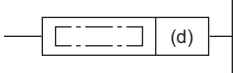
### Operation error

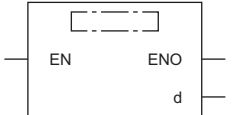
There is no operation error.

# Decrementing 32-bit binary data

## DDEC(P)(\_U)

These instructions decrement the specified 32-bit binary data by one.

| Ladder                                                                            | ST                                    |                                           |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------|
|  | ENO:=DDEC(EN,d);<br>ENO:=DDECP(EN,d); | ENO:=DDEC_U(EN,d);<br>ENO:=DDECP_U(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction      | Execution condition                                                               |
|------------------|-----------------------------------------------------------------------------------|
| DDEC<br>DDEC_U   |  |
| DDECP<br>DDECP_U |  |

## Setting data

## Description, range, data type

| Operand | Description         | Range                     | Data type              | Data type (label) |
|---------|---------------------|---------------------------|------------------------|-------------------|
| (d)     | DDEC(P)             | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | DDEC(P)_U           | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| EN      | Execution condition | —                         | Bit                    | BOOL              |
| ENO     | Execution result    | —                         | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |            |   |             | Double word |      | Indirect specification | Constant |    |   |   | Others |
|---------|----------------------------------|------|---------------------------------------|------------|---|-------------|-------------|------|------------------------|----------|----|---|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |   |        |
| (d)     | ○                                | ○    | ○                                     | ○          | ○ | ○           | ○           | ○    | ○                      | —        | —  | — | — |        |

## Processing details

- These instructions decrement the 32-bit binary data in the device specified by (d) by one.



- When the DDEC(P)(\_U) instruction is executed while the data in the device specified by (d) is -2147483648, 2147483647 is stored in the device specified by (d). (When a signed value is specified)
- When the DDEC(P)(\_U) instruction is executed while the data in the device specified by (d) is 0, -1 is stored in the device specified by (d). (When a signed value is specified)
- When the DDEC(P)(\_U) instruction is executed while the data in the device specified by (d) is 0, 4294967295 is stored in the device specified by (d). (When an unsigned value is specified)

## Operation error

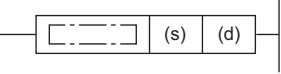
There is no operation error.

## 12.3 Logical Operation Instructions

### Performing an AND operation on 16-bit data

#### WAND(P) [when two operands are set]

These instructions perform an AND operation on the two sets of 16-bit binary data specified.

| Ladder                                                                            | ST                                                                                                                                                   |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Not supported<br>(  Page 328 WAND(P) [when three operands are set]) |

#### FBD/LD

Not supported  
( Page 328 WAND(P) [when three operands are set])

#### ■Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| WAND        |  |
| WANDP       |  |

#### Setting data

#### ■Description, range, data type

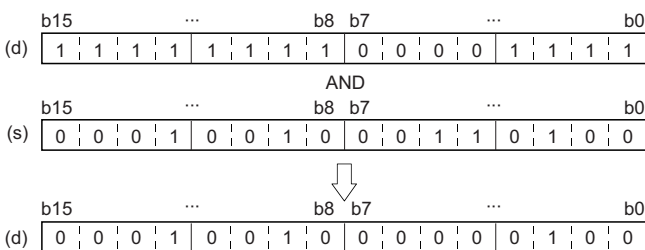
| Operand | Description                                                     | Range           | Data type            | Data type (label) |
|---------|-----------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s)     | Logical AND data or the device where logical AND data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Device for storing the operation result                         | -32768 to 32767 | 16-bit signed binary | ANY16             |

#### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |

#### Processing details

- These instructions perform an AND operation (bit-by-bit) on the 16-bit binary data in the device specified by (d) and the 16-bit binary data in the device specified by (s), and store the operation result in the device specified by (d).



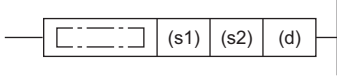
- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

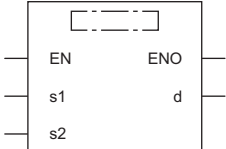
#### Operation error

There is no operation error.

## WAND(P) [when three operands are set]

These instructions perform an AND operation on the two sets of 16-bit binary data specified.

| Ladder                                                                            | ST                                                        |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|
|  | <pre>ENO:=WAND(EN,s1,s2,d); ENO:=WANDP(EN,s1,s2,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### ■Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| WAND        |  |
| WANDP       |  |

### Setting data

### ■Description, range, data type

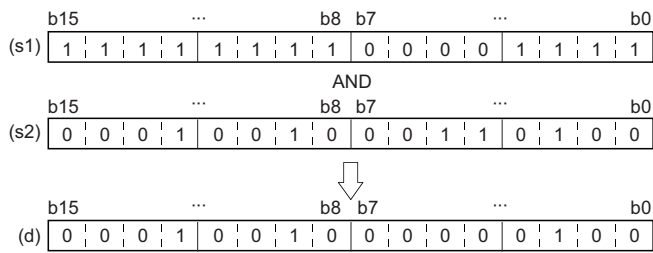
| Operand | Description                                                     | Range           | Data type            | Data type (label) |
|---------|-----------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s1)    | Logical AND data or the device where logical AND data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (s2)    | Logical AND data or the device where logical AND data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Device for storing the operation result                         | —               | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                             | —               | Bit                  | BOOL              |
| ENO     | Execution result                                                | —               | Bit                  | BOOL              |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions perform an AND operation (bit-by-bit) on the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

## Operation error

There is no operation error.

# Performing an AND operation on 32-bit data

## DAND(P) [when two operands are set]

These instructions perform an AND operation on the two sets of 32-bit binary data specified.

| Ladder | ST                                                                 |
|--------|--------------------------------------------------------------------|
|        | Not supported<br>( Page 332 DAND(P) [when three operands are set]) |

| FBD/LD                                                             |
|--------------------------------------------------------------------|
| Not supported<br>( Page 332 DAND(P) [when three operands are set]) |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DAND        |                     |
| DANDP       |                     |

## Setting data

## Description, range, data type

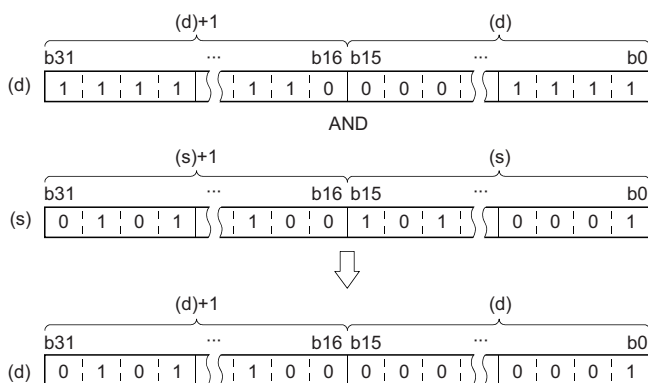
| Operand | Description                                                           | Range                     | Data type            | Data type (label) |
|---------|-----------------------------------------------------------------------|---------------------------|----------------------|-------------------|
| (s)     | Logical AND data or the start device where logical AND data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)     | Start device for storing the operation result                         | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |

## Applicable devices

| Operand | Bit                              |      | Word                                  |              | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|--------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○            | ○           | ○           | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○            | ○           | ○           | ○                      | —        | — | —  | —      |

## Processing details

- These instructions perform an AND operation (bit-by-bit) on the 32-bit binary data in the device specified by (d) and the 32-bit binary data in the device specified by (s), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.



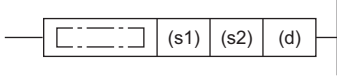
## Operation error

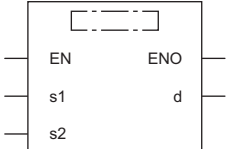
There is no operation error.

12

## DAND(P) [when three operands are set]

These instructions perform an AND operation on the two sets of 32-bit binary data specified.

| Ladder                                                                            | ST                                                        |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|
|  | <pre>ENO:=DAND(EN,s1,s2,d); ENO:=DANDP(EN,s1,s2,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### ■Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DAND        |  |
| DANDP       |  |

### Setting data

### ■Description, range, data type

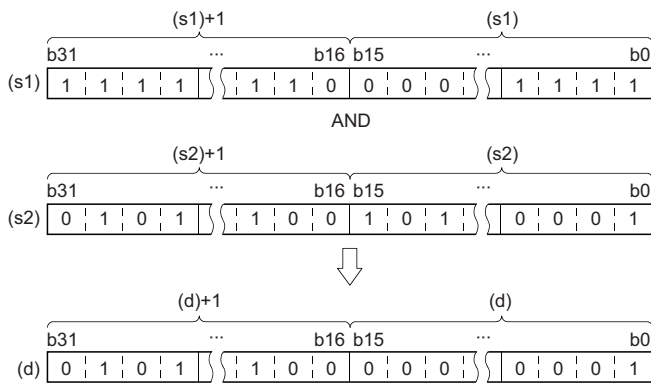
| Operand | Description                                                           | Range                     | Data type            | Data type (label) |
|---------|-----------------------------------------------------------------------|---------------------------|----------------------|-------------------|
| (s1)    | Logical AND data or the start device where logical AND data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (s2)    | Logical AND data or the start device where logical AND data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)     | Start device for storing the operation result                         | —                         | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                                   | —                         | Bit                  | BOOL              |
| ENO     | Execution result                                                      | —                         | Bit                  | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions perform an AND operation (bit-by-bit) on the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

## Operation error

There is no operation error.

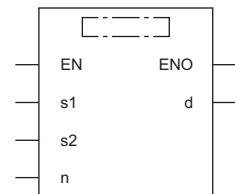
# Performing an AND operation on 16-bit block data

## BKAND(P)

These instructions perform an AND operation on the two 16-bit binary data blocks specified.

| Ladder | ST                                                              |
|--------|-----------------------------------------------------------------|
|        | <pre>ENO:=BKAND(EN,s1,s2,n,d); ENO:=BKANDP(EN,s1,s2,n,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BKAND       |                     |
| BKANDP      |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                           | Range           | Data type              | Data type (label)   |
|---------|-----------------------------------------------------------------------|-----------------|------------------------|---------------------|
| (s1)    | Logical AND data or the start device where logical AND data is stored | —               | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (s2)    | Logical AND data or the start device where logical AND data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (d)     | Start device for storing the operation result                         | —               | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (n)     | Number of data points                                                 | 0 to 65535      | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                                   | —               | Bit                    | BOOL                |
| ENO     | Execution result                                                      | —               | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

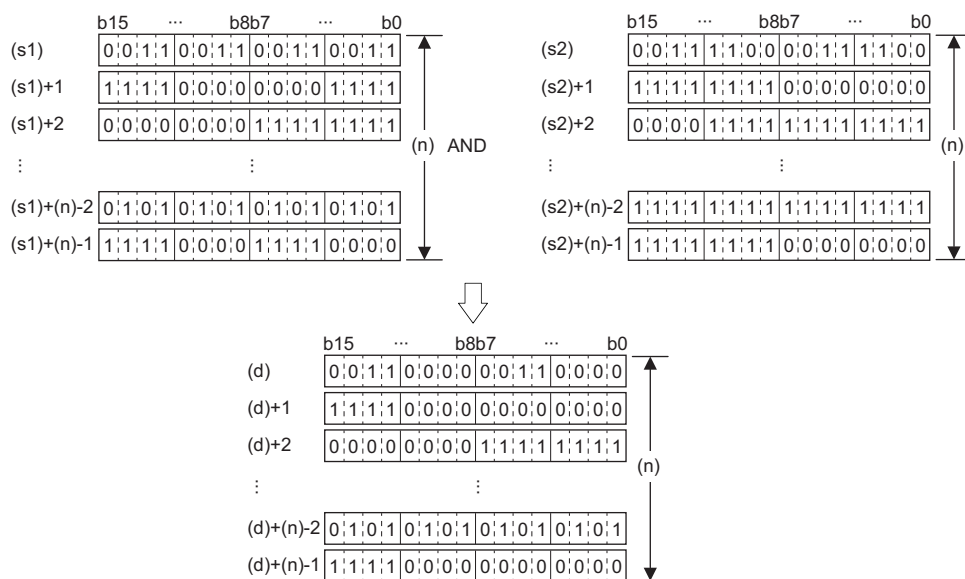
## Applicable devices

| Operand            | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|--------------------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|                    | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1) <sup>*1</sup> | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2) <sup>*1</sup> | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —      |
| (d) <sup>*1</sup>  | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)                | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

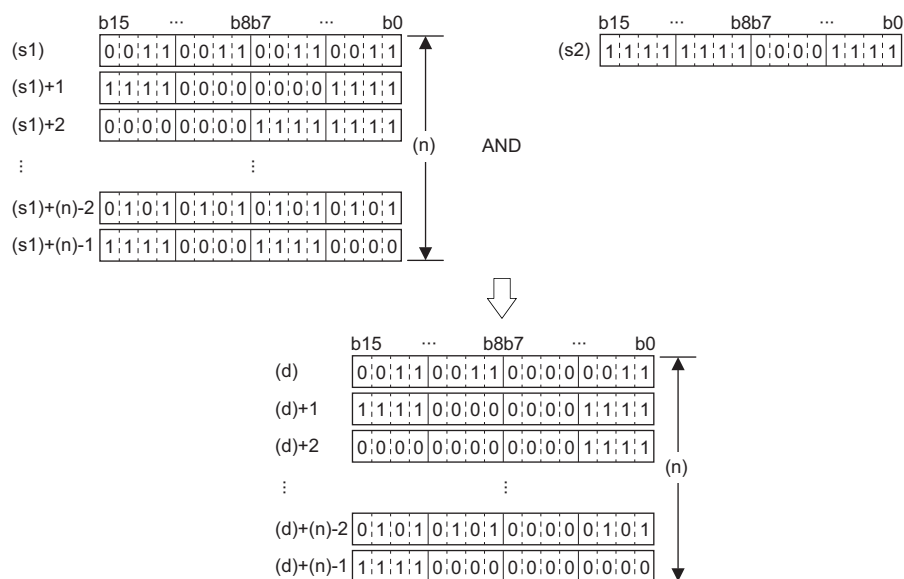
\*1 The same device number can be specified for (s1) and (d) or (s2) and (d).

## Processing details

- These instructions perform an AND operation on the (n) points of data from the device specified by (s1) and the (n) points of data from the device specified by (s2), and store the operation result in the device specified by (d) and later.



- A constant from -32768 to 32767 (16-bit signed binary) can be specified for (s2).



## Operation error

| Error code (SD0) | Description                                                                                                                                               |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The device ranges starting from the ones specified by (s1) and (d) are partially overlapping (except when the same device is specified for (s1) and (d)). |
|                  | The device ranges starting from the ones specified by (s2) and (d) are partially overlapping (except when the same device is specified for (s2) and (d)). |

# Performing an OR operation on 16-bit data

## WOR(P) [when two operands are set]

These instructions perform an OR operation on the two sets of 16-bit binary data specified.

| Ladder                                                            | ST                                                                |
|-------------------------------------------------------------------|-------------------------------------------------------------------|
|                                                                   | Not supported<br>( Page 337 WOR(P) [when three operands are set]) |
| FBD/LD                                                            |                                                                   |
| Not supported<br>( Page 337 WOR(P) [when three operands are set]) |                                                                   |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| WOR         |                     |
| WOP         |                     |

## Setting data

## Description, range, data type

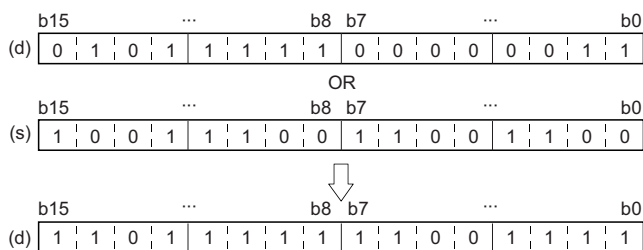
| Operand | Description                                                   | Range           | Data type            | Data type (label) |
|---------|---------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s)     | Logical OR data or the device where logical OR data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Device for storing the operation result                       | -32768 to 32767 | 16-bit signed binary | ANY16             |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions perform an OR operation (bit-by-bit) on the 16-bit binary data in the device specified by (d) and the 16-bit binary data in the device specified by (s), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

## Operation error

There is no operation error.

## WOR(P) [when three operands are set]

These instructions perform an OR operation on the two sets of 16-bit binary data specified.

| Ladder | ST                                                      |
|--------|---------------------------------------------------------|
|        | <pre>ENO:=WOR(EN,s1,s2,d); ENO:=WORP(EN,s1,s2,d);</pre> |
| FBD/LD |                                                         |
|        |                                                         |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| WOR         |                     |
| WORP        |                     |

### Setting data

### Description, range, data type

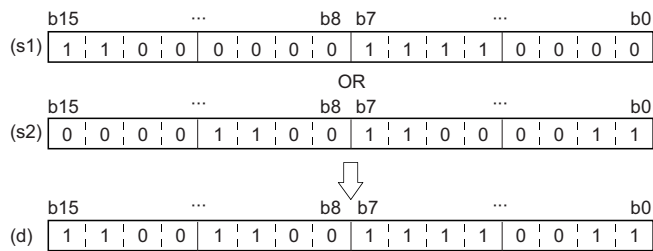
| Operand | Description                                                   | Range           | Data type            | Data type (label) |
|---------|---------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s1)    | Logical OR data or the device where logical OR data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (s2)    | Logical OR data or the device where logical OR data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Device for storing the operation result                       | —               | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                           | —               | Bit                  | BOOL              |
| ENO     | Execution result                                              | —               | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions perform an OR operation (bit-by-bit) on the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

## Operation error

There is no operation error.



## Performing an OR operation on 32-bit data

### DOR(P) [when two operands are set]

These instructions perform an OR operation on the two sets of 32-bit binary data specified.

| Ladder                                                            | ST                                                                |
|-------------------------------------------------------------------|-------------------------------------------------------------------|
|                                                                   | Not supported<br>( Page 341 DOR(P) [when three operands are set]) |
| FBD/LD                                                            |                                                                   |
| Not supported<br>( Page 341 DOR(P) [when three operands are set]) |                                                                   |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DOR         |                     |
| DORP        |                     |

### Setting data

### Description, range, data type

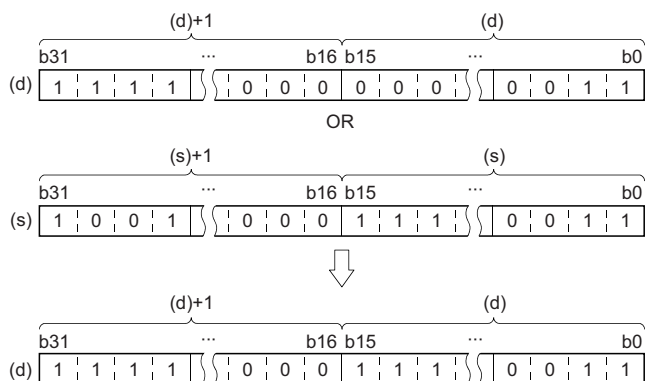
| Operand | Description                                                         | Range                     | Data type            | Data type (label) |
|---------|---------------------------------------------------------------------|---------------------------|----------------------|-------------------|
| (s)     | Logical OR data or the start device where logical OR data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)     | Start device for storing the operation result                       | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions perform an OR operation (bit-by-bit) on the 32-bit binary data in the device specified by (d) and the 32-bit binary data in the device specified by (s), and store the operation result in the device specified by (d).



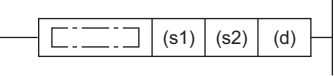
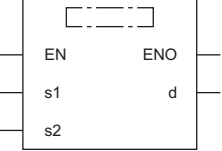
- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

## Operation error

There is no operation error.

## DOR(P) [when three operands are set]

These instructions perform an OR operation on the two sets of 32-bit binary data specified.

| Ladder                                                                            | ST                                                      |
|-----------------------------------------------------------------------------------|---------------------------------------------------------|
|  | <pre>ENO:=DOR(EN,s1,s2,d); ENO:=DORP(EN,s1,s2,d);</pre> |
| FBD/LD                                                                            |                                                         |
|  |                                                         |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DOR         |  |
| DORP        |  |

### Setting data

### Description, range, data type

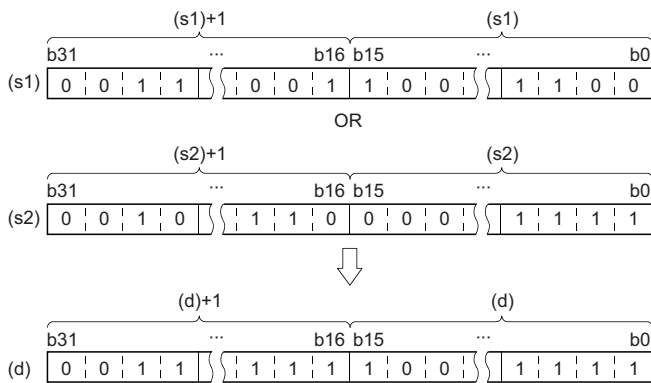
| Operand | Description                                                         | Range                     | Data type            | Data type (label) |
|---------|---------------------------------------------------------------------|---------------------------|----------------------|-------------------|
| (s1)    | Logical OR data or the start device where logical OR data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (s2)    | Logical OR data or the start device where logical OR data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)     | Start device for storing the operation result                       | —                         | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                                 | —                         | Bit                  | BOOL              |
| ENO     | Execution result                                                    | —                         | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions perform an OR operation (bit-by-bit) on the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

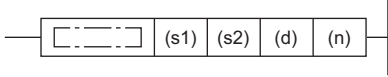
## Operation error

There is no operation error.

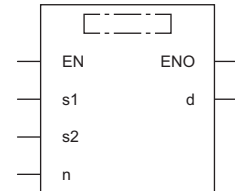
# Performing an OR operation on 16-bit block data

## BKOR(P)

These instructions perform an OR operation on the two 16-bit binary data blocks specified.

| Ladder                                                                            | ST                                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------|
|  | ENO:=BKOR(EN,s1,s2,n,d);<br>ENO:=BKORP(EN,s1,s2,n,d); |

## FBD/LD



## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| BKOR        |  |
| BKORP       |  |

## Setting data

## Description, range, data type

| Operand | Description                                                         | Range           | Data type              | Data type (label)   |
|---------|---------------------------------------------------------------------|-----------------|------------------------|---------------------|
| (s1)    | Logical OR data or the start device where logical OR data is stored | —               | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (s2)    | Logical OR data or the start device where logical OR data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (d)     | Start device for storing the operation result                       | —               | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (n)     | Number of data points                                               | 0 to 65535      | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                                 | —               | Bit                    | BOOL                |
| ENO     | Execution result                                                    | —               | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

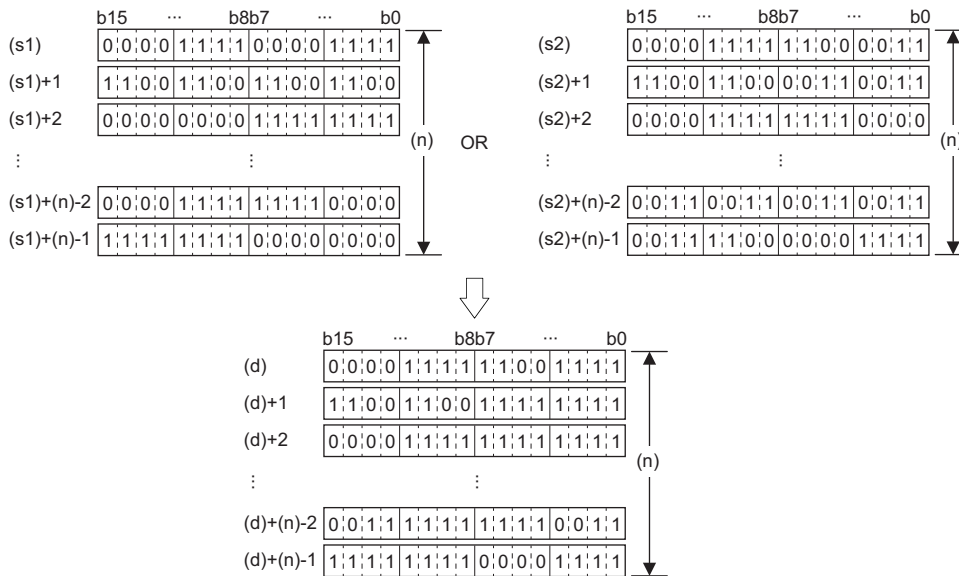
## Applicable devices

| Operand            | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|--------------------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|                    | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1) <sup>*1</sup> | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2) <sup>*1</sup> | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —      |
| (d) <sup>*1</sup>  | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)                | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

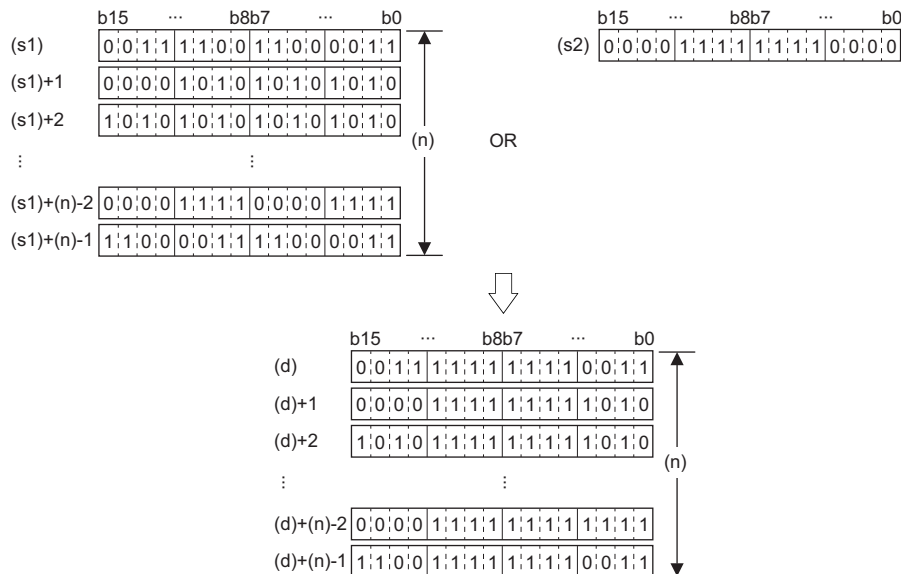
\*1 The same device number can be specified for (s1) and (d) or (s2) and (d).

## Processing details

- These instructions perform an OR operation on the (n) points of data from the device specified by (s1) and the (n) points of data from the device specified by (s2), and store the operation result in the device specified by (d) and later.



- A constant from -32768 to 32767 (16-bit signed binary) can be specified for (s2).



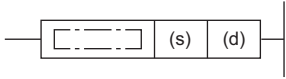
## Operation error

| Error code (SD0) | Description                                                                                                                                               |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The device ranges starting from the ones specified by (s1) and (d) are partially overlapping (except when the same device is specified for (s1) and (d)). |
|                  | The device ranges starting from the ones specified by (s2) and (d) are partially overlapping (except when the same device is specified for (s2) and (d)). |

## Performing an XOR operation on 16-bit data

### WXOR(P) [when two operands are set]

These instructions perform an XOR operation on the two sets of 16-bit binary data specified.

| Ladder                                                                            | ST                                                                 |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------|
|  | Not supported<br>( Page 346 WXOR(P) [when three operands are set]) |
| FBD/LD                                                                            |                                                                    |
| Not supported<br>( Page 346 WXOR(P) [when three operands are set])                |                                                                    |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| WXOR        |  |
| WXORP       |  |

### Setting data

### Description, range, data type

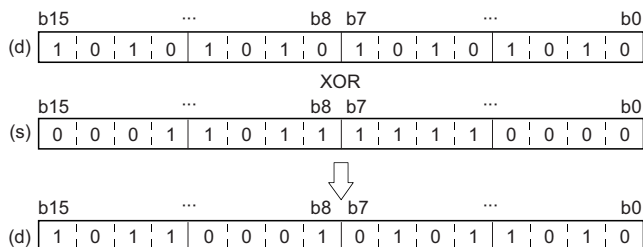
| Operand | Description                                                       | Range           | Data type            | Data type (label) |
|---------|-------------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s)     | Exclusive OR data or the device where exclusive OR data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Device for storing the operation result                           | -32768 to 32767 | 16-bit signed binary | ANY16             |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   |             | Double word |      | Indirect specification | Constant |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|-------------|------|------------------------|----------|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |        |
| (s)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —           | ○    | ○                      | —        | —  | — |        |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —           | ○    | —                      | —        | —  | — |        |

### Processing details

- These instructions perform an XOR operation (bit-by-bit) on the 16-bit binary data in the device specified by (d) and the 16-bit binary data in the device specified by (s), and store the operation result in the device specified by (d).



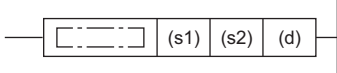
- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

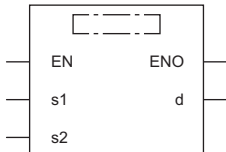
### Operation error

There is no operation error.

## WXOR(P) [when three operands are set]

These instructions perform an XOR operation on the two sets of 16-bit binary data specified.

| Ladder                                                                            | ST                                                        |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|
|  | <pre>ENO:=WXOR(EN,s1,s2,d); ENO:=WXORP(EN,s1,s2,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### ■Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| WXOR        |  |
| WXORP       |  |

### Setting data

### ■Description, range, data type

| Operand | Description                                                       | Range           | Data type            | Data type (label) |
|---------|-------------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s1)    | Exclusive OR data or the device where exclusive OR data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (s2)    | Exclusive OR data or the device where exclusive OR data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Device for storing the operation result                           | —               | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                               | —               | Bit                  | BOOL              |
| ENO     | Execution result                                                  | —               | Bit                  | BOOL              |

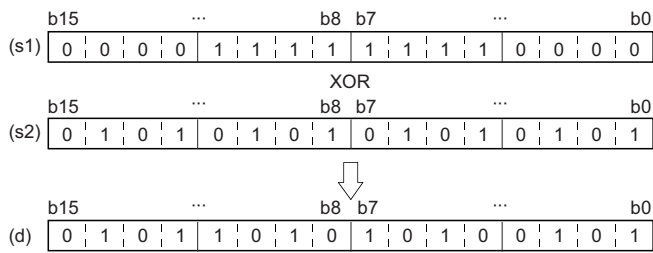
### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |



## Processing details

- These instructions perform an XOR operation (bit-by-bit) on the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

## Operation error

There is no operation error.

# Performing an XOR operation on 32-bit data

## DXOR(P) [when two operands are set]

These instructions perform an XOR operation on the two sets of 32-bit binary data specified.

| Ladder                                                             | ST                                                                 |
|--------------------------------------------------------------------|--------------------------------------------------------------------|
|                                                                    | Not supported<br>( Page 350 DXOR(P) [when three operands are set]) |
| FBD/LD                                                             |                                                                    |
| Not supported<br>( Page 350 DXOR(P) [when three operands are set]) |                                                                    |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DXOR        |                     |
| DXORP       |                     |

## Setting data

## Description, range, data type

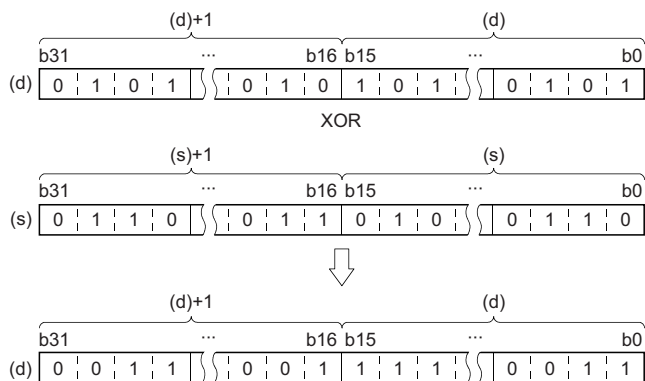
| Operand | Description                                                             | Range                     | Data type            | Data type (label) |
|---------|-------------------------------------------------------------------------|---------------------------|----------------------|-------------------|
| (s)     | Exclusive OR data or the start device where exclusive OR data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)     | Start device for storing the operation result                           | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions perform an XOR operation (bit-by-bit) on the 32-bit binary data in the device specified by (d) and the 32-bit binary data in the device specified by (s), and store the operation result in the device specified by (d).



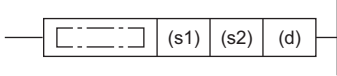
- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

## Operation error

There is no operation error.

## DXOR(P) [when three operands are set]

These instructions perform an XOR operation on the two sets of 32-bit binary data specified.

| Ladder                                                                            | ST                                                        |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|
|  | <pre>ENO:=DXOR(EN,s1,s2,d); ENO:=DXORP(EN,s1,s2,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DXOR        |  |
| DXORP       |  |

### Setting data

### Description, range, data type

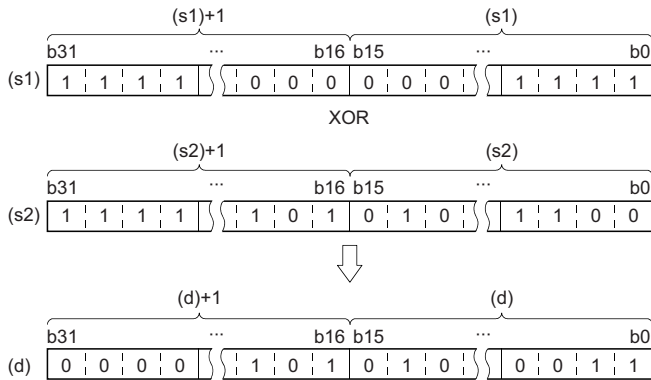
| Operand | Description                                                             | Range                     | Data type            | Data type (label) |
|---------|-------------------------------------------------------------------------|---------------------------|----------------------|-------------------|
| (s1)    | Exclusive OR data or the start device where exclusive OR data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (s2)    | Exclusive OR data or the start device where exclusive OR data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)     | Start device for storing the operation result                           | —                         | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                                     | —                         | Bit                  | BOOL              |
| ENO     | Execution result                                                        | —                         | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions perform an XOR operation (bit-by-bit) on the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

## Operation error

There is no operation error.

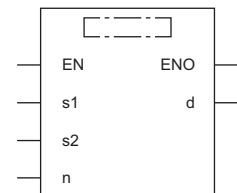
# Performing an XOR operation on 16-bit block data

## BKXOR(P)

These instructions perform an XOR operation on the two 16-bit binary data blocks specified.

| Ladder | ST                                                      |
|--------|---------------------------------------------------------|
|        | ENO:=BKXOR(EN,s1,s2,n,d);<br>ENO:=BKXORP(EN,s1,s2,n,d); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BKXOR       |                     |
| BKXORP      |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                           | Range           | Data type              | Data type (label)   |
|---------|---------------------------------------------------------------------------------------|-----------------|------------------------|---------------------|
| (s1)    | Start device where the logical operation data is stored                               | —               | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (s2)    | Logical operation data or the start device where the logical operation data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (d)     | Start device for storing the operation result                                         | —               | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (n)     | Number of data points                                                                 | 0 to 65535      | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                                                   | —               | Bit                    | BOOL                |
| ENO     | Execution result                                                                      | —               | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

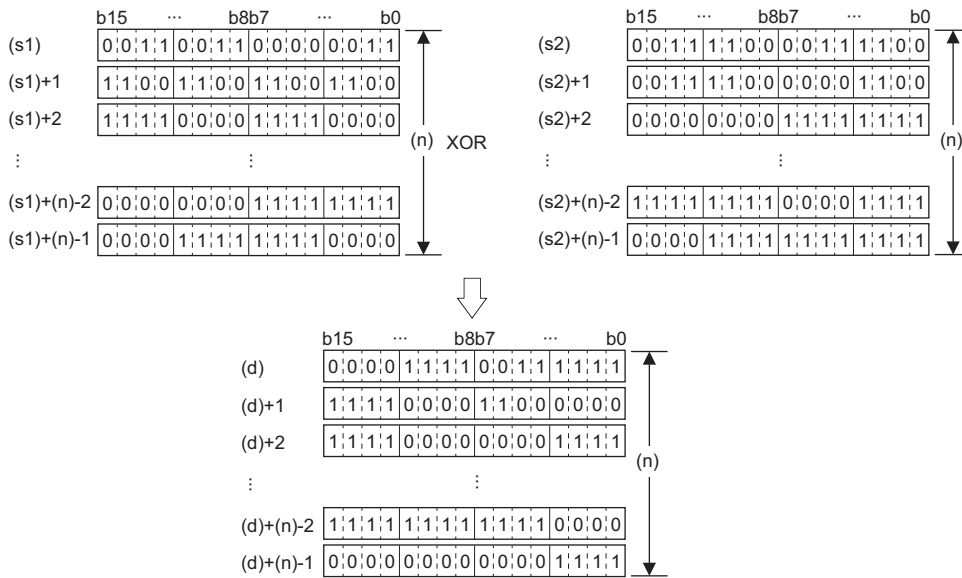
## Applicable devices

| Operand            | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|--------------------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|                    | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1) <sup>*1</sup> | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2) <sup>*1</sup> | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —      |
| (d) <sup>*1</sup>  | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)                | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

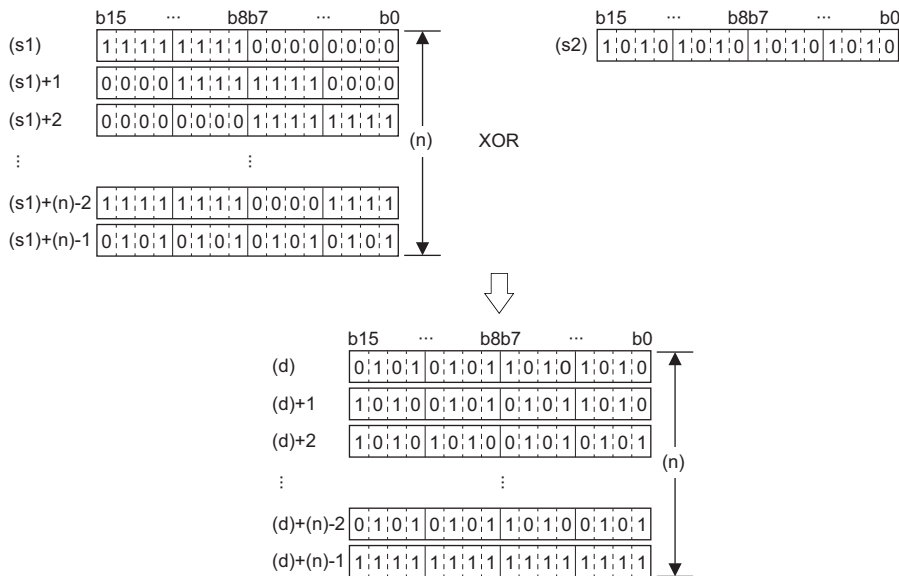
\*1 The same device number can be specified for (s1) and (d) or (s2) and (d).

## Processing details

- These instructions perform an XOR operation on the (n) points of data from the device specified by (s1) and the (n) points of data from the device specified by (s2), and store the operation result in the device specified by (d) and later.



- A constant from -32768 to 32767 (16-bit signed binary) can be specified for (s2).



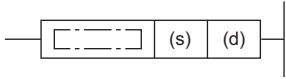
## Operation error

| Error code (SD0) | Description                                                                                                                                               |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The device ranges starting from the ones specified by (s1) and (d) are partially overlapping (except when the same device is specified for (s1) and (d)). |
|                  | The device ranges starting from the ones specified by (s2) and (d) are partially overlapping (except when the same device is specified for (s2) and (d)). |

# Performing an XNOR operation on 16-bit data

## WXNR(P) [when two operands are set]

These instructions perform an XNOR operation on the two sets of 16-bit binary data specified.

| Ladder                                                                            | ST                                                                 |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------|
|  | Not supported<br>( Page 355 WXNR(P) [when three operands are set]) |
| FBD/LD                                                                            |                                                                    |
| Not supported<br>( Page 355 WXNR(P) [when three operands are set])                |                                                                    |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| WXNR        |  |
| WXNRP       |  |

## Setting data

## Description, range, data type

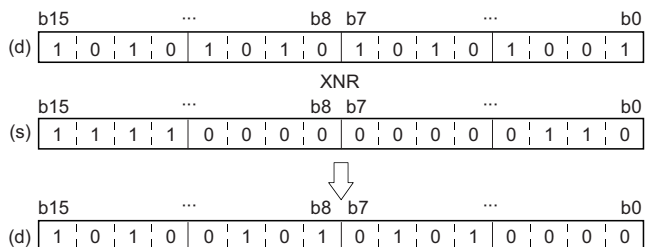
| Operand | Description                                                         | Range           | Data type            | Data type (label) |
|---------|---------------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s)     | Exclusive NOR data or the device where exclusive NOR data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Device for storing the operation result                             | -32768 to 32767 | 16-bit signed binary | ANY16             |

## Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions perform an XNOR operation on the 16-bit binary data in the device specified by (d) and the 16-bit binary data in the device specified by (s), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

## Operation error

There is no operation error.



## WXNR(P) [when three operands are set]

These instructions perform an XNOR operation on the two sets of 16-bit binary data specified.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | ENO:=WXNR(EN,s1,s2,d);<br>ENO:=WXNRP(EN,s1,s2,d); |
| FBD/LD |                                                   |
|        |                                                   |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| WXNR        |                     |
| WXNRP       |                     |

### Setting data

### Description, range, data type

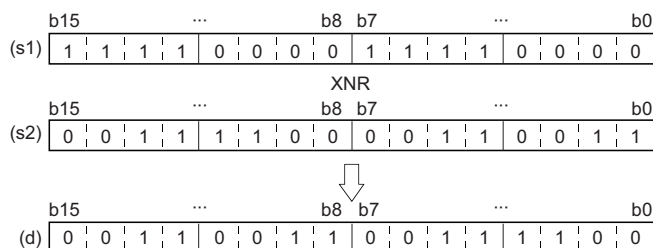
| Operand    | Description                                                         | Range           | Data type            | Data type (label) |
|------------|---------------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s1), (s2) | Exclusive NOR data or the device where exclusive NOR data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)        | Device for storing the operation result                             | —               | 16-bit signed binary | ANY16             |
| EN         | Execution condition                                                 | —               | Bit                  | BOOL              |
| ENO        | Execution result                                                    | —               | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions perform an exclusive NOR operation on the 16-bit binary data in the device specified by (s1) and the 16-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

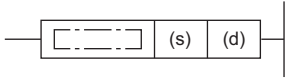
## Operation error

There is no operation error.

# Performing an XNOR operation on 32-bit data

## DXNR(P) [when two operands are set]

These instructions perform an XNOR operation on the two sets of 32-bit binary data specified.

| Ladder                                                                            | ST                                                                 |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------|
|  | Not supported<br>( Page 359 DXNR(P) [when three operands are set]) |
| FBD/LD                                                                            |                                                                    |
| Not supported<br>( Page 359 DXNR(P) [when three operands are set])                |                                                                    |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DXNR        |  |
| DXNRP       |  |

## Setting data

## Description, range, data type

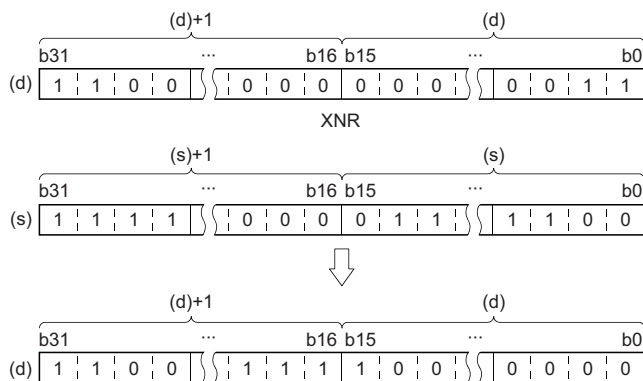
| Operand | Description                                                               | Range                     | Data type            | Data type (label) |
|---------|---------------------------------------------------------------------------|---------------------------|----------------------|-------------------|
| (s)     | Exclusive NOR data or the start device where exclusive NOR data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)     | Start device for storing the operation result                             | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions perform an XNOR operation on the 32-bit binary data in the device specified by (d) and the 32-bit binary data in the device specified by (s), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

## Operation error

There is no operation error.

## DXNR(P) [when three operands are set]

These instructions perform an XNOR operation on the two sets of 32-bit binary data specified.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=DXNR(EN,s1,s2,d); ENO:=DXNRP(EN,s1,s2,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DXNR        |                     |
| DXNRP       |                     |

### Setting data

#### Description, range, data type

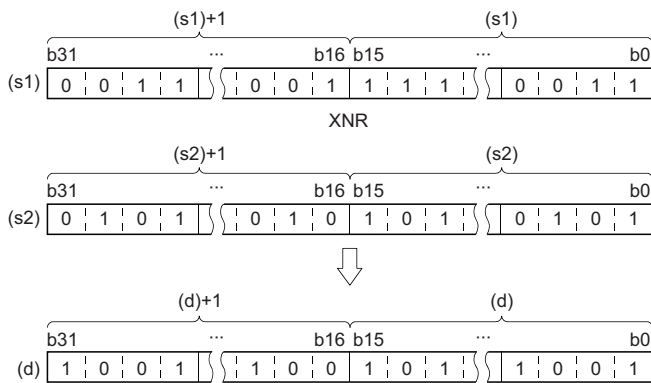
| Operand    | Description                                                               | Range                     | Data type            | Data type (label) |
|------------|---------------------------------------------------------------------------|---------------------------|----------------------|-------------------|
| (s1), (s2) | Exclusive NOR data or the start device where exclusive NOR data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)        | Start device for storing the operation result                             | —                         | 32-bit signed binary | ANY32             |
| EN         | Execution condition                                                       | —                         | Bit                  | BOOL              |
| ENO        | Execution result                                                          | —                         | Bit                  | BOOL              |

#### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   |             | Double word |      | Indirect specification | Constant |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|-------------|------|------------------------|----------|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○           | ○    | ○                      | ○        | —  | — | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○           | ○    | ○                      | ○        | —  | — | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○           | ○    | ○                      | —        | —  | — | —      |

## Processing details

- These instructions perform an XNOR operation on the 32-bit binary data in the device specified by (s1) and the 32-bit binary data in the device specified by (s2), and store the operation result in the device specified by (d).



- When a bit device is specified, the instruction performs an operation by assuming that the ones after the number of digit-specified points are 0.

## Operation error

There is no operation error.

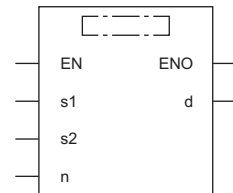
# Performing an XNOR operation on 16-bit block data

## BKXNR(P)

These instructions perform an XNOR operation on the two 16-bit binary data blocks specified.

| Ladder | ST                                                      |
|--------|---------------------------------------------------------|
|        | ENO:=BKXNR(EN,s1,s2,n,d);<br>ENO:=BKXNRP(EN,s1,s2,n,d); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BKXNR       |                     |
| BKXNRP      |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                           | Range           | Data type              | Data type (label)   |
|---------|---------------------------------------------------------------------------------------|-----------------|------------------------|---------------------|
| (s1)    | Start device where the logical operation data is stored                               | —               | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (s2)    | Logical operation data or the start device where the logical operation data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (d)     | Start device for storing the operation result                                         | —               | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (n)     | Number of data points                                                                 | 0 to 65535      | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                                                   | —               | Bit                    | BOOL                |
| ENO     | Execution result                                                                      | —               | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

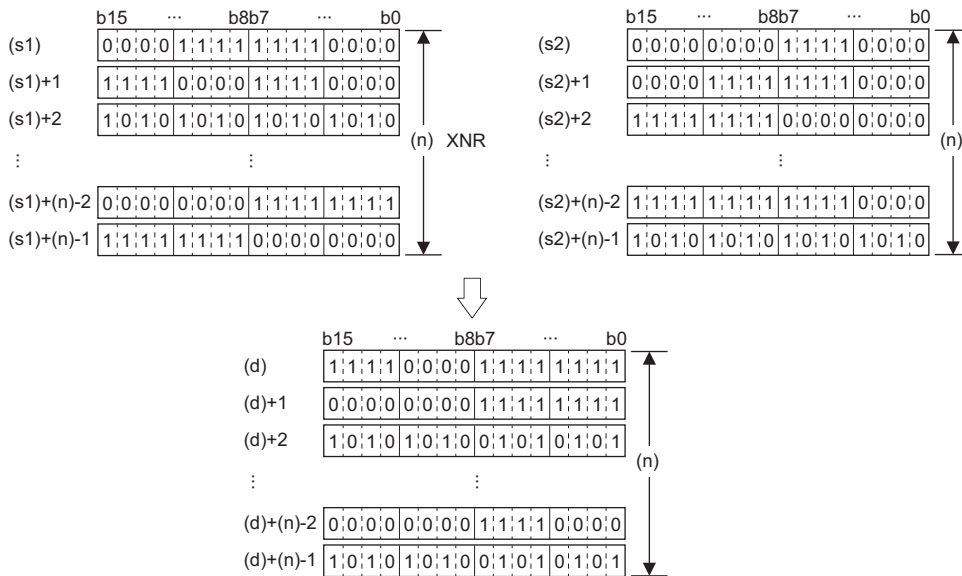
## Applicable devices

| Operand            | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|--------------------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|                    | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1) <sup>*1</sup> | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2) <sup>*1</sup> | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —      |
| (d) <sup>*1</sup>  | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)                | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

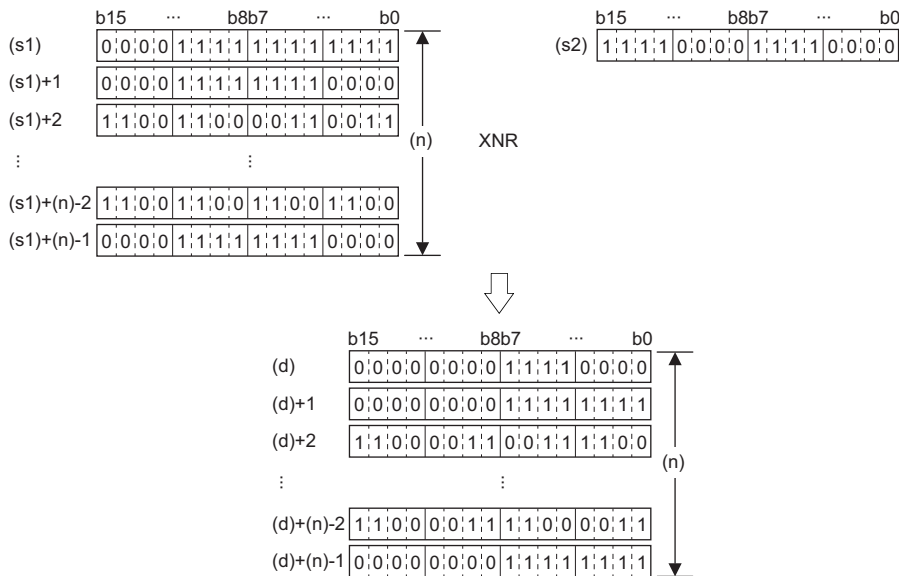
\*1 The same device number can be specified for (s1) and (d) or (s2) and (d).

## Processing details

- These instructions perform an exclusive NOR operation on the (n) points of data from the device specified by (s1) and the (n) points of data from the device specified by (s2), and store the operation result in the device specified by (d) and later.



- A constant from -32768 to 32767 (16-bit signed binary) can be specified for (s2).



## Operation error

| Error code (SD0) | Description                                                                                                                                               |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The device ranges starting from the ones specified by (s1) and (d) are partially overlapping (except when the same device is specified for (s1) and (d)). |
|                  | The device ranges starting from the ones specified by (s2) and (d) are partially overlapping (except when the same device is specified for (s2) and (d)). |



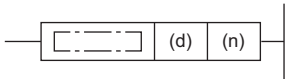
# 12.4 Bit Processing Instructions

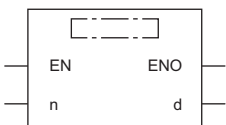
12

## Setting a bit in the word device

### BSET(P)

These instructions set the 'n'th bit in the specified word device to 1.

| Ladder                                                                            | ST                                        |
|-----------------------------------------------------------------------------------|-------------------------------------------|
|  | ENO:=BSET(EN,n,d);<br>ENO:=BSETP(EN,n,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| BSET        |   |
| BSETP       |  |

### Setting data

### Description, range, data type

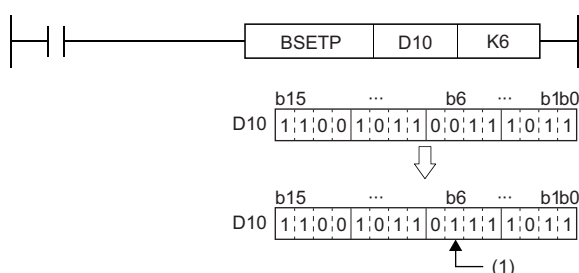
| Operand | Description             | Range   | Data type              | Data type (label) |
|---------|-------------------------|---------|------------------------|-------------------|
| (d)     | Set target device       | —       | 16-bit signed binary   | ANY16             |
| (n)     | Set target bit position | 0 to 15 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition     | —       | Bit                    | BOOL              |
| ENO     | Execution result        | —       | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

### Processing details

- These instructions set the 'n'th bit in the word device specified by (d) to 1.



(1) Set b6 of D10 to 1.

- If (n) exceeds 15, the instruction sets lower 4 bits of data.

## Operation error

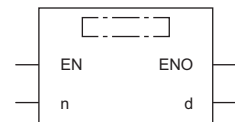
There is no operation error.

## Resetting a bit in the word device

### BRST(P)

These instructions reset the 'n'th bit in the specified word device to 0.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | <pre>ENO:=BRST(EN,n,d); ENO:=BRSTP(EN,n,d);</pre> |
| FBD/LD |                                                   |



### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BRST        |                     |
| BRSTP       |                     |

### Setting data

### Description, range, data type

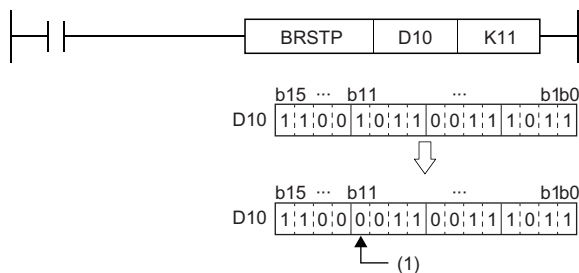
| Operand | Description               | Range   | Data type              | Data type (label) |
|---------|---------------------------|---------|------------------------|-------------------|
| (d)     | Reset target device       | —       | 16-bit signed binary   | ANY16             |
| (n)     | Reset target bit position | 0 to 15 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition       | —       | Bit                    | BOOL              |
| ENO     | Execution result          | —       | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | — |        |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | — |        |

### Processing details

- These instructions reset the 'n'th bit in the word device specified by (d) to 0.



(1) Reset b11 of D10 to 0.

- If (n) exceeds 15, the instruction sets lower 4 bits of data.

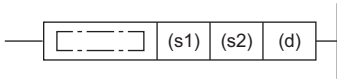
### Operation error

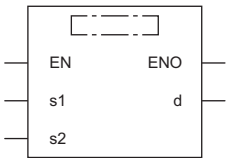
There is no operation error.

## Performing a 16-bit test

### TEST(P)

These instructions extract the 'n'th bit in the specified word device.

| Ladder                                                                            | ST                                                        |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|
|  | <pre>ENO:=TEST(EN,s1,s2,d); ENO:=TESTP(EN,s1,s2,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| TEST        |  |
| TESTP       |  |

### Setting data

### Description, range, data type

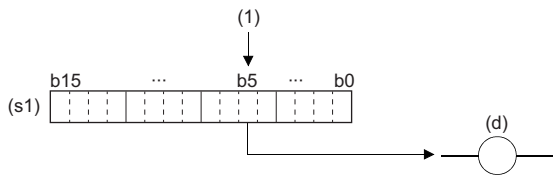
| Operand | Description                                        | Range   | Data type              | Data type (label) |
|---------|----------------------------------------------------|---------|------------------------|-------------------|
| (s1)    | Device where the extract target bit data is stored | —       | 16-bit signed binary   | ANY16             |
| (s2)    | Extract target bit position                        | 0 to 15 | 16-bit unsigned binary | ANY16             |
| (d)     | Device for storing the extracted bit data          | —       | Bit                    | ANY_BOOL          |
| EN      | Execution condition                                | —       | Bit                    | BOOL              |
| ENO     | Execution result                                   | —       | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions extract the bit data at the position specified by (s2) of the word device specified by (s1), and write it to the bit device specified by (d).



(1) (s2) bit (When (s2)=5)

- The bit device specified by (d) turns off when the extracted bit data is 0 and turns on when the bit data is 1.
- Specify the bit position (0 to 15) of the word data in (s2). When 16 or a greater value is specified in (s2), the remainder of  $(s2) \div 16$  becomes the bit position.

**Ex.**

When (s2)=18: The remainder of  $18 \div 16$  is 2, and therefore the data in bit 2 will be extracted.

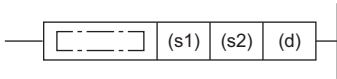
## Operation error

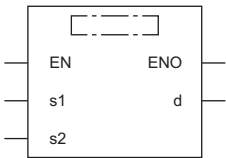
There is no operation error.

## Performing a 32-bit test

### DTEST(P)

These instructions extract the 'n'th bit in the specified double-word device.

| Ladder                                                                            | ST                                                          |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|
|  | <pre>ENO:=DTEST(EN,s1,s2,d); ENO:=DTESTP(EN,s1,s2,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DTEST       |  |
| DTESTP      |  |

### Setting data

### Description, range, data type

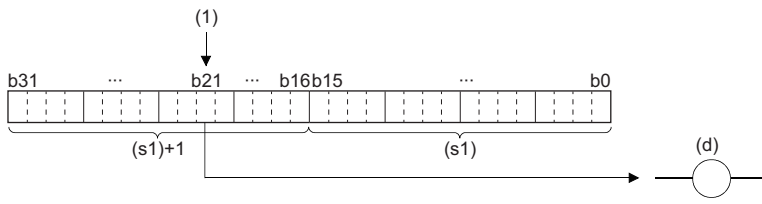
| Operand | Description                                        | Range   | Data type              | Data type (label) |
|---------|----------------------------------------------------|---------|------------------------|-------------------|
| (s1)    | Device where the extract target bit data is stored | —       | 32-bit signed binary   | ANY32             |
| (s2)    | Extract target bit position                        | 0 to 31 | 16-bit unsigned binary | ANY16             |
| (d)     | Device for storing the extracted bit data          | —       | Bit                    | ANY_BOOL          |
| EN      | Execution condition                                | —       | Bit                    | BOOL              |
| ENO     | Execution result                                   | —       | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions extract the bit data at the position specified by (s2) of the double-word device specified by (s1), and write it to the bit device specified by (d).



(1) (s2) bit (When (s2)=21)

- The bit device specified by (d) turns off when the extracted bit data is 0 and turns on when the bit data is 1.
- Specify the bit position (0 to 31) of the double-word data in (s2). When 32 or a greater value is specified in (s2), the remainder of  $(s2) \div 32$  becomes the bit position.

**Ex.**

When (s2)=34: The remainder of  $34 \div 32$  is 2, and therefore the data in bit 2 will be extracted.

## Operation error

There is no operation error.

# Batch-resetting bit devices

## BKRST(P)

These instructions reset the (n) points of bit devices starting from the bit device specified.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | <pre>ENO:=BKRST(EN,n,d); ENO:=BKRSTP(EN,n,d);</pre> |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BKRST       |                     |
| BKRSTP      |                     |

## Setting data

## Description, range, data type

| Operand | Description                    | Range      | Data type              | Data type (label) |
|---------|--------------------------------|------------|------------------------|-------------------|
| (d)     | Start device to be reset       | —          | Bit                    | ANY_BOOL          |
| (n)     | Number of reset target devices | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition            | —          | Bit                    | BOOL              |
| ENO     | Execution result               | —          | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○                                | ○   | ○                                     | —         | — | ○           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions reset the (n) points of bit devices starting from the bit device specified by (d).
- The following table lists the reset status of the bit devices.

| Device                                                                                                       | Status                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Annunciator (F)                                                                                              | <ul style="list-style-type: none"> <li>The (n) points of data starting from the annunciator (F) number in the device specified by (d) turn off.</li> <li>The annunciator numbers that turned off are deleted from SD64 to SD79, and the remaining data are compressed forward.</li> <li>The number of annunciators stored in SD64 to SD79 is stored in SD63.</li> </ul> |
| Timer (T), retentive timer (ST), counter (C), long timer (LT), long retentive timer (LST), long counter (LC) | <ul style="list-style-type: none"> <li>The (n) points, starting from the timer (T), retentive timer (ST), counter (C), long timer (LT), long retentive timer (LST), or long counter (LC) number in the device specified by (d), of current values are reset to 0, and the (n) points of coils and contacts are turned off.</li> </ul>                                   |
| Bit devices other than the above                                                                             | <ul style="list-style-type: none"> <li>The (n) points, starting from the device specified by (d), of coils and contacts are turned off.</li> </ul>                                                                                                                                                                                                                      |

- When the specified device is off, the device status does not change.



## Operation error

There is no operation error.

12

# 12.5 Shift Instructions

## Shifting 16-bit binary data to the right by n bit(s)

### SFR(P)

These instructions shift the 16-bit binary data in the specified device to the right by (n) bit(s). In the empty area after the shift, 0 is stored.

| Ladder | ST                                      |
|--------|-----------------------------------------|
|        | ENO:=SFR(EN,n,d);<br>ENO:=SFRP(EN,n,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SFR         |                     |
| SFRP        |                     |

### Setting data

### Description, range, data type

| Operand | Description         | Range   | Data type              | Data type (label) |
|---------|---------------------|---------|------------------------|-------------------|
| (d)     | Shift target device | —       | 16-bit signed binary   | ANY16             |
| (n)     | Number of shifts    | 0 to 15 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition | —       | Bit                    | BOOL              |
| ENO     | Execution result    | —       | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○*1                              | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○*1                              | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

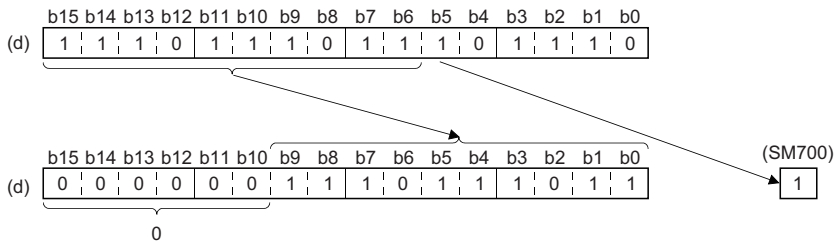
\*1 FX and FY cannot be used.

## Processing details

- These instructions shift the 16-bit binary data in the device specified by (d) to the right by (n) bit(s).
- The (n) bit(s) from the most significant bit is/are filled with 0(s).
- In SM700 (carry flag), a value in a bit to the right of the shift target area is stored.

**Ex.**

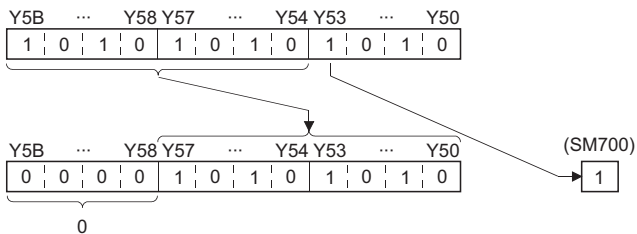
When (n)=6



- When (d) is a bit device, bits are shifted to the right within the device range specified by digit specification.

**Ex.**

When (n)=4



- The number of bits actually to be shifted is the remainder of  $(n) \div (\text{specified number of bits})$ . For example, when (n) is 15 and the specified number of bits is 8, 7 bits are shifted because 15 divided by 8 equals 1 with a remainder of 7.
- Specify any value between 0 and 15 for (n). If a value 16 or bigger is specified, bits are shifted by the remainder value of  $n \div 16$ . For example, when (n) is 18, 2 bits are shifted to the right because 18 divided by 16 equals 1 with a remainder of 2.

## Operation error

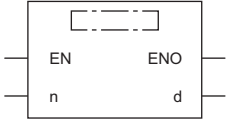
There is no operation error.

## Shifting 16-bit binary data to the left by n bit(s)

### SFL(P)

These instructions shift the 16-bit binary data in the specified device to the left by (n) bit(s). In the empty area after the shift, 0 is stored.

| Ladder                                                                            | ST                                      |
|-----------------------------------------------------------------------------------|-----------------------------------------|
|  | ENO:=SFL(EN,n,d);<br>ENO:=SFLP(EN,n,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| SFL         |  |
| SFLP        |  |

### Setting data

### Description, range, data type

| Operand | Description         | Range   | Data type              | Data type (label) |
|---------|---------------------|---------|------------------------|-------------------|
| (d)     | Shift target device | —       | 16-bit signed binary   | ANY16             |
| (n)     | Number of shifts    | 0 to 15 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition | —       | Bit                    | BOOL              |
| ENO     | Execution result    | —       | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○*1                              | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○*1                              | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

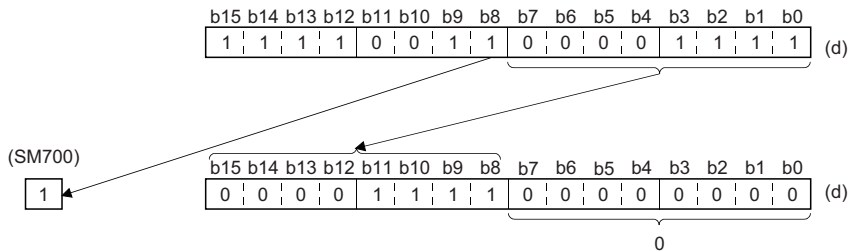
\*1 FX and FY cannot be used.

## Processing details

- This instruction shifts the 16-bit binary data in the device specified by (d) to the left by (n) bit(s).
- The (n) bit(s) from the least significant bit is/are filled with 0(s).
- In SM700 (carry flag), a value in a bit to the left of the shift target area is stored.

**Ex.**

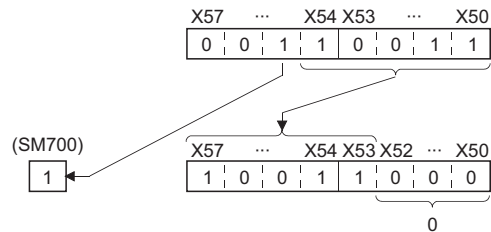
When (n)=8



- When (d) is a bit device, bits are shifted to the left within the device range specified by digit specification.

**Ex.**

When (n)=5



- The number of bits actually to be shifted is the remainder of (n)÷(specified number of bits). For example, when (n) is 15 and the specified number of bits is 8, 7 bits are shifted because 15 divided by 8 equals 1 with a remainder of 7.
- Specify any value between 0 and 15 for (n). If a value 16 or larger is specified, the value is shifted by the remainder value of n÷16 to the left. For example, when (n) is 18, 2 bits are shifted to the left because 18 divided by 16 equals 1 with a remainder of 2.

## Operation error

There is no operation error.

# Shifting n-bit data to the right by one bit

## BSFR(P)

These instructions shift the (n) points of data starting from the specified device to the right by one bit. In the empty area after the shift, 0 is stored.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | <pre>ENO:=BSFR(EN,n,d); ENO:=BSFRP(EN,n,d);</pre> |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BSFR        |                     |
| BSFRP       |                     |

## Setting data

## Description, range, data type

| Operand | Description                  | Range      | Data type              | Data type (label) |
|---------|------------------------------|------------|------------------------|-------------------|
| (d)     | Shift target device          | —          | Bit                    | ANY_BOOL          |
| (n)     | Amount of data to be shifted | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition          | —          | Bit                    | BOOL              |
| ENO     | Execution result             | —          | Bit                    | BOOL              |

## Applicable devices

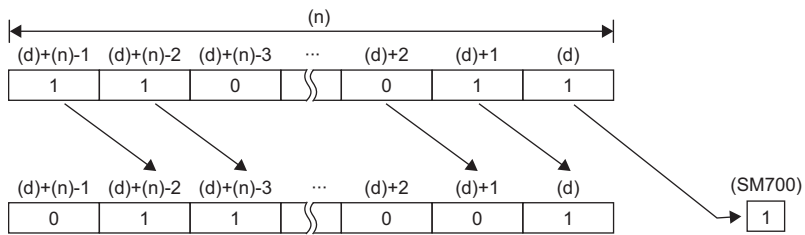
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○*1                              | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○*2                              | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

\*1 T, C, and ST cannot be used.

\*2 FX and FY cannot be used.

## Processing details

- These instructions shift the (n) points of data starting from the device specified by (d) to the right by one bit.
- The most significant bit is filled with 0.
- In SM700 (carry flag), a value in a bit to the right of the shift target area is stored.



- If the value specified by (n) is 0, the instruction will be not processed.

## Operation error

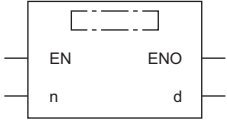
There is no operation error.

# Shifting n-bit data to the left by one bit

## BSFL(P)

These instructions shift the (n) points of data starting from the specified device to the left by one bit. In the empty area after the shift, 0 is stored.

| Ladder                                                                            | ST                                        |
|-----------------------------------------------------------------------------------|-------------------------------------------|
|  | ENO:=BSFL(EN,n,d);<br>ENO:=BSFLP(EN,n,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| BSFL        |  |
| BSFLP       |  |

## Setting data

## Description, range, data type

| Operand | Description                  | Range      | Data type              | Data type (label) |
|---------|------------------------------|------------|------------------------|-------------------|
| (d)     | Shift target device          | —          | Bit                    | ANY_BOOL          |
| (n)     | Amount of data to be shifted | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition          | —          | Bit                    | BOOL              |
| ENO     | Execution result             | —          | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○*1                              | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○*2                              | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

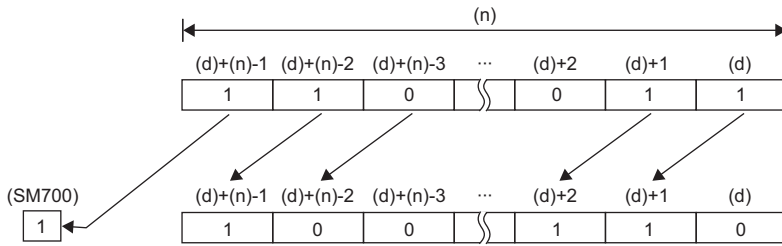
\*1 T, C, and ST cannot be used.

\*2 FX and FY cannot be used.



## Processing details

- These instructions shift the (n) points of data starting from the device specified by (d) to the left by one bit.
- The least significant bit is filled with 0.
- In SM700 (carry flag), a value in a bit to the left of the shift target area is stored.



- If the value specified by (n) is 0, the instruction will be not processed.

## Operation error

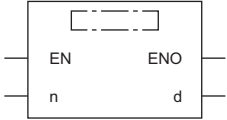
There is no operation error.

# Shifting n-word data to the right by one word

## DSFR(P)

These instructions shift the (n) points of data starting from the specified device to the right by one word. In the empty area after the shift, 0 is stored.

| Ladder                                                                            | ST                                                |
|-----------------------------------------------------------------------------------|---------------------------------------------------|
|  | <pre>ENO:=DSFR(EN,n,d); ENO:=DSFRP(EN,n,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DSFR        |  |
| DSFRP       |  |

## Setting data

## Description, range, data type

| Operand | Description                  | Range      | Data type              | Data type (label) |
|---------|------------------------------|------------|------------------------|-------------------|
| (d)     | Shift target device          | —          | Word                   | ANY16             |
| (n)     | Amount of data to be shifted | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition          | —          | Bit                    | BOOL              |
| ENO     | Execution result             | —          | Bit                    | BOOL              |

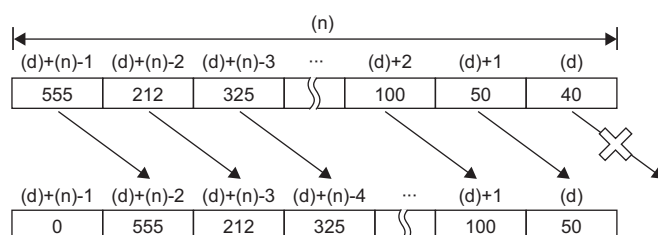
## Applicable devices

| Operand | Bit                              |     | Word                                  |            | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (d)     | —                                | —   | ○                                     | —          | —           | —           | ○                      | —        | — | —  | —      |
| (n)     | ○*1                              | ○   | ○                                     | ○          | ○           | —           | ○                      | ○        | — | —  | —      |

\*1 FX and FY cannot be used.

## Processing details

- These instructions shift the (n) points of data starting from the device specified by (d) to the right by one word.
- One word from the most significant bit is filled with 0.



- If the value specified by (n) is 0, the instruction will be not processed.

## Operation error

There is no operation error.

12

# Shifting n-word data to the left by one word

## DSFL(P)

These instructions shift the (n) points of data starting from the specified device to the left by one word. In the empty area after the shift, 0 is stored.

| Ladder | ST                                        |
|--------|-------------------------------------------|
|        | ENO:=DSFL(EN,n,d);<br>ENO:=DSFLP(EN,n,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DSFL        |                     |
| DSFLP       |                     |

### Setting data

### Description, range, data type

| Operand | Description                  | Range      | Data type              | Data type (label) |
|---------|------------------------------|------------|------------------------|-------------------|
| (d)     | Shift target device          | —          | Word                   | ANY16             |
| (n)     | Amount of data to be shifted | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition          | —          | Bit                    | BOOL              |
| ENO     | Execution result             | —          | Bit                    | BOOL              |

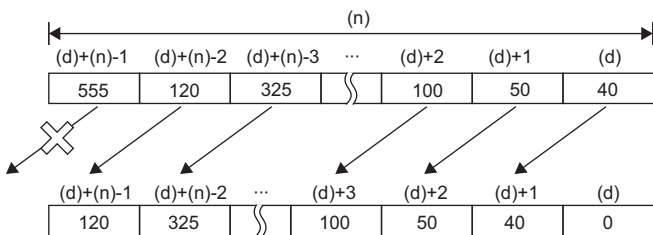
### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○*1                              | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

\*1 FX and FY cannot be used.

### Processing details

- These instructions shift the (n) points of data starting from the device specified by (d) to the left by one word.
- One word from the least significant bit is filled with 0.



- If (n) is 0, no processing is performed.

## Operation error

There is no operation error.

12

## Shifting n-bit data to the right by n bit(s)

### SFTBR(P)

These instructions shift the bit data to the right by (n2) bit(s) within (n1) bits starting from the specified device. In the empty area after the shift, 0 is stored.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | ENO:=SFTBR(EN,n1,n2,d);<br>ENO:=SFTBRP(EN,n1,n2,d); |
| FBD/LD |                                                     |
|        |                                                     |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SFTBR       |                     |
| SFTBRP      |                     |

### Setting data

### Description, range, data type

| Operand | Description                  | Range      | Data type              | Data type (label) |
|---------|------------------------------|------------|------------------------|-------------------|
| (d)     | Shift target device          | —          | Bit                    | ANY_BOOL          |
| (n1)    | Amount of data to be shifted | 0 to 64    | 16-bit unsigned binary | ANY16             |
| (n2)    | Number of shifts             | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition          | —          | Bit                    | BOOL              |
| ENO     | Execution result             | —          | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              | Word |                                       |            | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (d)     | ○*1                              | —    | ○                                     | —          | —           | —           | ○                      | —        | — | —  | —      |
| (n1)    | ○*2                              | ○    | ○                                     | ○          | ○           | —           | ○                      | ○        | — | —  | —      |
| (n2)    | ○*2                              | ○    | ○                                     | ○          | ○           | —           | ○                      | ○        | — | —  | —      |

\*1 T, C, and ST cannot be used.

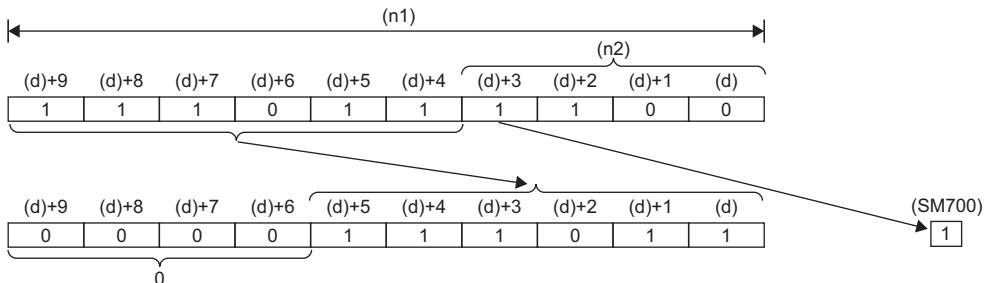
\*2 FX and FY cannot be used.

## Processing details

- These instructions shift bit data to the right by the (n2) bit(s) within the (n1) bits of data area starting from the device specified by (d).
- In SM700 (carry flag), a value in a bit to the right of the shift target area is stored.

### Ex.

When (n1)=10 and (n2)=4



- Specify (n1) and (n2) so that the following condition is satisfied:  $(n1) > (n2)$ . In the case of  $(n1) \leq (n2)$ , data is shifted by the value of the remainder of  $(n2) \div (n1)$ . However, if the remainder value is 0, no processing is performed.
- Specify (n1) within the range of 1 to 64.
- The (n2) bit(s) from the most significant bit is/are filled with 0(s). In the case of  $(n1) < (n2)$ , the bits are filled with 0s by the value of the remainder of  $(n2) \div (n1)$ .
- If (n1) or (n2) is 0, no processing is performed.

## Operation error

| Error code (SD0) | Description                                               |
|------------------|-----------------------------------------------------------|
| 3285H            | The value specified by (n1) is out of the range, 0 to 64. |

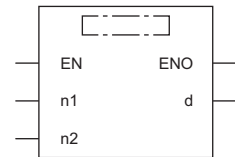
# Shifting n-bit data to the left by n bit(s)

## SFTBL(P)

These instructions shift the bit data to the left by (n2) bit(s) within (n1) bits starting from the specified device. In the empty area after the shift, 0 is stored.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | ENO:=SFTBL(EN,n1,n2,d);<br>ENO:=SFTBLP(EN,n1,n2,d); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SFTBL       |                     |
| SFTBLP      |                     |

## Setting data

## Description, range, data type

| Operand | Description                  | Range      | Data type              | Data type (label) |
|---------|------------------------------|------------|------------------------|-------------------|
| (d)     | Shift target device          | —          | Bit                    | ANY_BOOL          |
| (n1)    | Amount of data to be shifted | 0 to 64    | 16-bit unsigned binary | ANY16             |
| (n2)    | Number of shifts             | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition          | —          | Bit                    | BOOL              |
| ENO     | Execution result             | —          | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              | Word |                                       |            | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (d)     | ○*1                              | —    | ○                                     | —          | —           | —           | ○                      | —        | — | —  | —      |
| (n1)    | ○*2                              | ○    | ○                                     | ○          | ○           | —           | ○                      | ○        | — | —  | —      |
| (n2)    | ○*2                              | ○    | ○                                     | ○          | ○           | —           | ○                      | ○        | — | —  | —      |

\*1 T, C, and ST cannot be used.

\*2 FX and FY cannot be used.

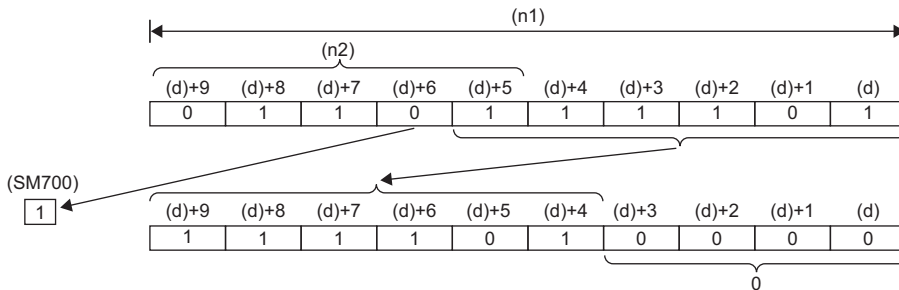


## Processing details

- These instructions shift bit data to the left by the (n2) bit(s) within the (n1) bits of data area starting from the device specified by (d).
- In SM700 (carry flag), a value in a bit to the left of the shift target area is stored.

### Ex.

When (n1)=10 and (n2)=4



- Specify (n1) and (n2) so that the following condition is satisfied:  $(n1) > (n2)$ . In the case of  $(n1) \leq (n2)$ , data is shifted by the value of the remainder of  $(n2) \div (n1)$ . However, if the remainder value is 0, no processing is performed.
- Specify (n1) within the range of 1 to 64.
- The (n2) bit(s) from the least significant bit is/are filled with 0(s). In the case of  $(n1) < (n2)$ , the bits are filled with 0s by the value of the remainder of  $(n2) \div (n1)$ .
- If (n1) or (n2) is 0, no processing is performed.

## Operation error

| Error code (SD0) | Description                                               |
|------------------|-----------------------------------------------------------|
| 3285H            | The value specified by (n1) is out of the range, 0 to 64. |

## Shifting n-word data to the right by n word(s)

### SFTWR(P)

These instructions shift the word data to the right by (n2) word(s) within (n1) words starting from the specified device. In the empty area after the shift, 0 is stored.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | ENO:=SFTWR(EN,n1,n2,d);<br>ENO:=SFTWRP(EN,n1,n2,d); |
| FBD/LD |                                                     |
|        |                                                     |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SFTWR       |                     |
| SFTWRP      |                     |

### Setting data

### Description, range, data type

| Operand | Description                  | Range      | Data type              | Data type (label) |
|---------|------------------------------|------------|------------------------|-------------------|
| (d)     | Shift target device          | —          | Word                   | ANY16             |
| (n1)    | Amount of data to be shifted | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| (n2)    | Number of shifts             | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition          | —          | Bit                    | BOOL              |
| ENO     | Execution result             | —          | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | —                                | —    | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n1)    | ○*1                              | ○    | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (n2)    | ○*1                              | ○    | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

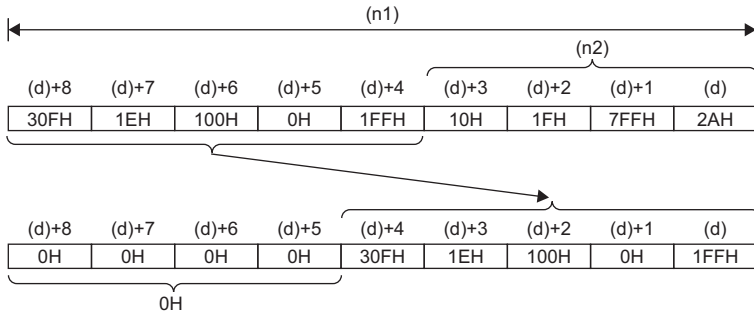
\*1 FX and FY cannot be used.

## Processing details

- These instructions shift word data to the right by the (n2) word(s) within the (n1) words of data area starting from the device specified by (d).
- The (n2) word(s) from the most significant bit is/are filled with 0H(s).
- If (n1) or (n2) is 0H, no processing is performed.
- In the case of  $(n1) \leq (n2)$ , (n1) words of data starting from the device specified by (d) become all 0Hs.

**Ex.**

When (n1)=9 and (n2)=4



## Operation error

There is no operation error.

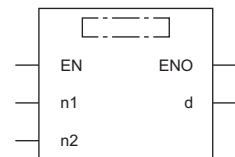
# Shifting n-word data to the left by n word(s)

## SFTWL(P)

These instructions shift the word data to the left by (n2) word(s) within (n1) words starting from the specified device. In the empty area after the shift, 0 is stored.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | ENO:=SFTWL(EN,n1,n2,d);<br>ENO:=SFTWLP(EN,n1,n2,d); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SFTWL       |                     |
| SFTWLP      |                     |

## Setting data

## Description, range, data type

| Operand | Description                  | Range      | Data type              | Data type (label) |
|---------|------------------------------|------------|------------------------|-------------------|
| (d)     | Shift target device          | —          | Word                   | ANY16             |
| (n1)    | Amount of data to be shifted | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| (n2)    | Number of shifts             | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition          | —          | Bit                    | BOOL              |
| ENO     | Execution result             | —          | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | —                                | —    | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n1)    | ○*1                              | ○    | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (n2)    | ○*1                              | ○    | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

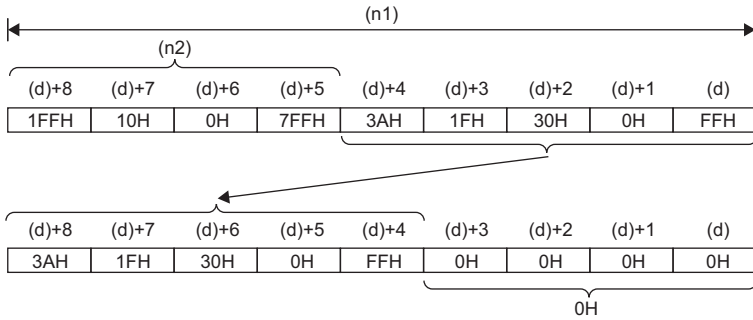
\*1 FX and FY cannot be used.

## Processing details

- These instructions shift word data to the left by the (n2) word(s) within the (n1) words of data area starting from the device specified by (d).
- The (n2) word(s) from the least significant bit is/are filled with 0H(s).
- If (n1) or (n2) is 0H, no processing is performed.
- In the case of  $(n1) \leq (n2)$ , (n1) words of data starting from the device specified by (d) become all 0Hs.

**Ex.**

When (n1)=9 and (n2)=4



## Operation error

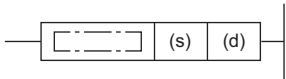
There is no operation error.

# 12.6 Data Conversion Instructions

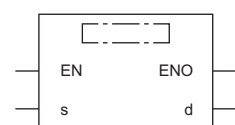
## Converting binary data to BCD 4-digit data

### BCD(P)

These instructions convert the specified 16-bit binary data to BCD 4-digit data.

| Ladder                                                                            | ST                                      |
|-----------------------------------------------------------------------------------|-----------------------------------------|
|  | ENO:=BCD(EN,s,d);<br>ENO:=BCDP(EN,s,d); |

### FBD/LD



### ■Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| BCD         |   |
| BCDP        |  |

### Setting data

### ■Description, range, data type

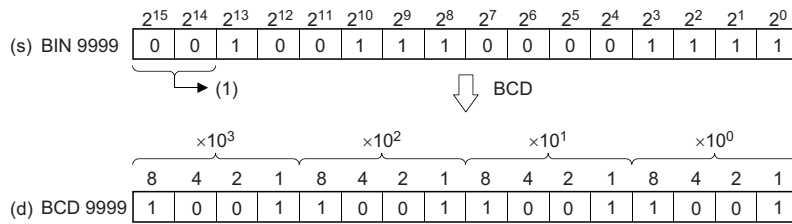
| Operand | Description                                               | Range     | Data type            | Data type (label) |
|---------|-----------------------------------------------------------|-----------|----------------------|-------------------|
| (s)     | Binary data or the device where the binary data is stored | 0 to 9999 | 16-bit signed binary | ANY16             |
| (d)     | Device for storing the converted BCD data                 | —         | BCD 4-digit          | ANY16             |
| EN      | Execution condition                                       | —         | Bit                  | BOOL              |
| ENO     | Execution result                                          | —         | Bit                  | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

These instructions convert the 16-bit binary data (0 to 9999) in the device specified by (s) to BCD 4-digit data, and store the converted data in the device specified by (d).



(1) Make sure to set them to "0".

## Operation error

| Error code<br>(SD0) | Description                                                         |
|---------------------|---------------------------------------------------------------------|
| 3281H               | Data in the device specified by (s) is out of the range, 0 to 9999. |

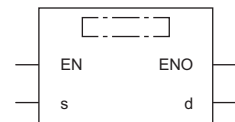
# Converting binary data to BCD 8-digit data

## DBCD(P)

These instructions convert the specified 32-bit binary data to BCD 8-digit data.

| Ladder | ST                                        |
|--------|-------------------------------------------|
|        | ENO:=DBCD(EN,s,d);<br>ENO:=DBCDP(EN,s,d); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DBCD        |                     |
| DBCDP       |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                     | Range         | Data type            | Data type (label) |
|---------|-----------------------------------------------------------------|---------------|----------------------|-------------------|
| (s)     | Binary data or the start device where the binary data is stored | 0 to 99999999 | 32-bit signed binary | ANY32             |
| (d)     | Start device for storing the converted BCD data                 | —             | BCD 8-digit          | ANY32             |
| EN      | Execution condition                                             | —             | Bit                  | BOOL              |
| ENO     | Execution result                                                | —             | Bit                  | BOOL              |

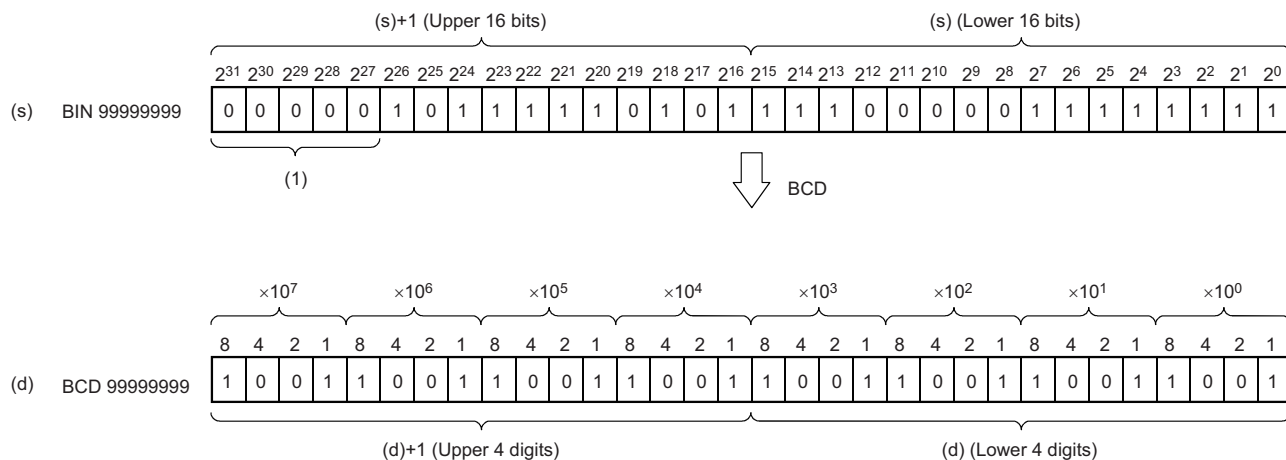
## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |



## Processing details

These instructions convert the 32-bit binary data (0 to 99999999) in the device specified by (s) to BCD 8-digit data, and store the converted data in the device specified by (d).



(1) Make sure to set them to "0". (Upper 5 bits)

## Operation error

| Error code (SD0) | Description                                                             |
|------------------|-------------------------------------------------------------------------|
| 3281H            | Data in the device specified by (s) is out of the range, 0 to 99999999. |

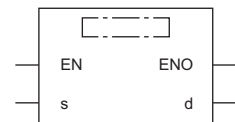
# Converting BCD 4-digit data to 16-bit binary data

## BIN(P)

These instructions convert the specified BCD 4-digit data to 16-bit binary data.

| Ladder | ST                                      |
|--------|-----------------------------------------|
|        | ENO:=BIN(EN,s,d);<br>ENO:=BINP(EN,s,d); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BIN         |                     |
| BINP        |                     |

## Setting data

## Description, range, data type

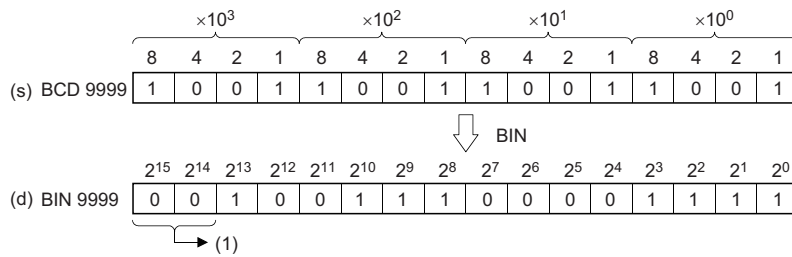
| Operand | Description                                         | Range     | Data type            | Data type (label) |
|---------|-----------------------------------------------------|-----------|----------------------|-------------------|
| (s)     | BCD data or the device where the BCD data is stored | 0 to 9999 | BCD 4-digit          | ANY16             |
| (d)     | Device for storing the converted binary data        | —         | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                 | —         | Bit                  | BOOL              |
| ENO     | Execution result                                    | —         | Bit                  | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

These instructions convert the BCD 4-digit data (0 to 9999) in the device specified by (s) to 16-bit binary data, and store the converted data in the device specified by (d).



(1) Always becomes "0".

## Operation error

| Error code (SD0) | Description                                                                                              |
|------------------|----------------------------------------------------------------------------------------------------------|
| 3281H            | A value other than 0 to 9 exists at any digit of the value in the device specified by (s). <sup>*1</sup> |

<sup>\*1</sup> Turning on SM754 (BIN, DBIN instruction error disable flag) can prevent this error from being detected.

If the specified value is out of the valid range, the BIN(P) instruction is not executed regardless of the status (on/off) of SM754.

The BIN(P) instruction does not execute the next operation until the command (execution condition) is turned off and on regardless of the presence of an error.

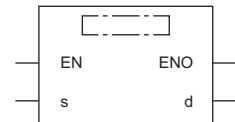
# Converting BCD 8-digit data to 32-bit binary data

## DBIN(P)

These instructions convert the specified BCD 8-digit data to 32-bit binary data.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | <pre>ENO:=DBIN(EN,s,d); ENO:=DBINP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DBIN        |                     |
| DBINP       |                     |

## Setting data

## Description, range, data type

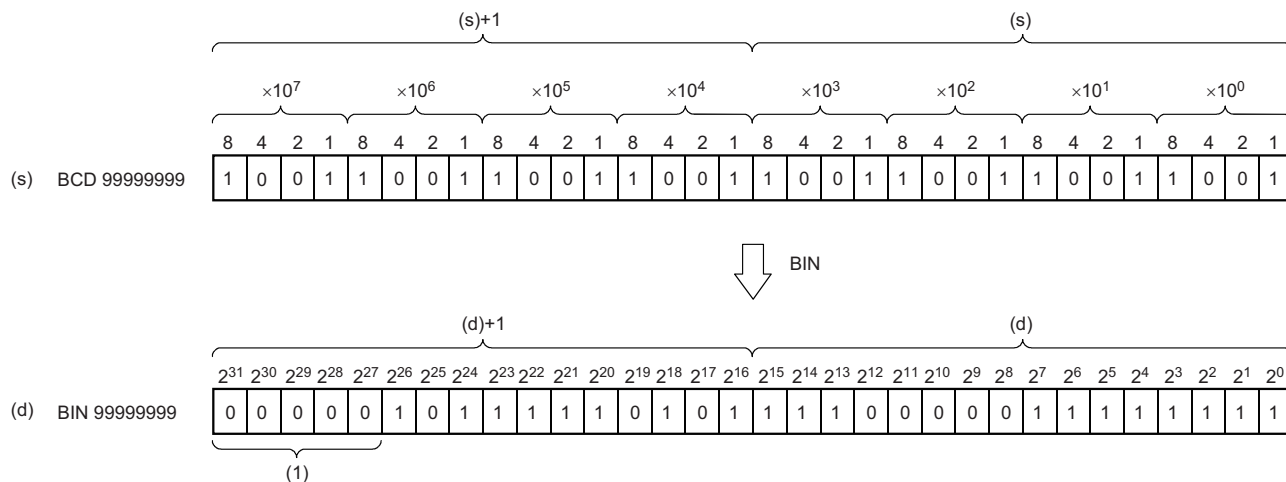
| Operand | Description                                               | Range         | Data type            | Data type (label) |
|---------|-----------------------------------------------------------|---------------|----------------------|-------------------|
| (s)     | BCD data or the start device where the BCD data is stored | 0 to 99999999 | BCD 8-digit          | ANY32             |
| (d)     | Start device for storing the converted binary data        | —             | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                       | —             | Bit                  | BOOL              |
| ENO     | Execution result                                          | —             | Bit                  | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

These instructions convert the BCD 8-digit data (0 to 99999999) in the device specified by (s) to 32-bit binary data, and store the converted data in the device specified by (d).



(1) Always becomes "0".

## Operation error

| Error code (SD0) | Description                                                                                              |
|------------------|----------------------------------------------------------------------------------------------------------|
| 3281H            | A value other than 0 to 9 exists at any digit of the value in the device specified by (s). <sup>*1</sup> |

<sup>\*1</sup> Turning on SM754 (BIN, DBIN instruction error disable flag) can prevent this error from being detected.

If the specified value is out of the valid range, the BIN(P) instruction is not executed regardless of the status (on/off) of SM754.

The DBIN(P) instruction does not execute the next operation until the command (execution condition) is turned off and on regardless of the presence of an error.

# Converting single-precision real number to 16-bit signed binary data

## FLT2INT(P)

These instructions convert the specified single-precision real number to 16-bit signed binary data.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | ENO:=FLT2INT(EN,s,d);<br>ENO:=FLT2INTP(EN,s,d); |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| FLT2INT     |                     |
| FLT2INTP    |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                                       | Range           | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------|-----------------|------------------------------|-------------------|
| (s)     | Single-precision real number or the start device where the single-precision real number is stored | -32768 to 32767 | Single-precision real number | ANYREAL_32        |
| (d)     | Device for storing the converted binary data                                                      | —               | 16-bit signed binary         | ANY16_S           |
| EN      | Execution condition                                                                               | —               | Bit                          | BOOL              |
| ENO     | Execution result                                                                                  | —               | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |           | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○         | ○           | ○           | ○                      | —        | ○ | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○           | —           | —                      | —        | — | —  | —      |

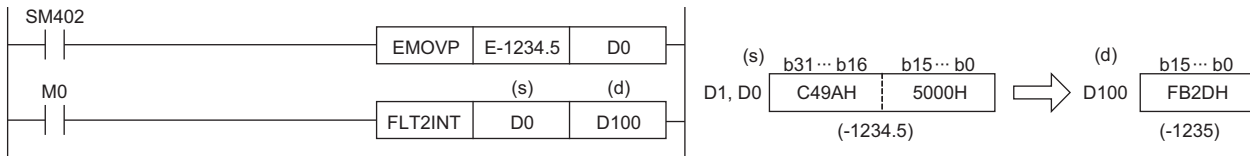
## Processing details

- These instructions convert the single-precision real number in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d).
- After conversion, the first digit after the decimal point of the single-precision real number is rounded off.
- When an input value is set using the engineering tool, a rounding error may occur. For the precautions on setting an input value using the engineering tool, refer to the following.

☞ Page 40 Precautions

### Ex.

When M0 turns on, the single-precision real number stored in D0 and D1 are converted to 16-bit signed binary data, and the converted data is stored in D100.



## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The single-precision real number in the device specified by (s) is out of the range, -32768 to 32767.                                                                                                                                                                                                                                             |
| 3282H            | An unusual number is set to (s). <ul style="list-style-type: none"> <li>• The single-precision real number set to (s) is not within the following range:<br/> <math>0, 2^{-126} \leq  (s)  &lt; 2^{128}</math></li> <li>• The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

# Converting single-precision real number to 16-bit unsigned binary data

## FLT2UINT(P)

These instructions convert the specified single-precision real number to 16-bit unsigned binary data.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=FLT2UINT(EN,s,d); ENO:=FLT2UINTP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| FLT2UINT    |                     |
| FLT2UINTP   |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                                                       | Range      | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------|------------|------------------------------|-------------------|
| (s)     | Single-precision real number or the start device where the single-precision real number is stored | 0 to 65535 | Single-precision real number | ANYREAL_32        |
| (d)     | Device for storing the converted binary data                                                      | —          | 16-bit unsigned binary       | ANY16_U           |
| EN      | Execution condition                                                                               | —          | Bit                          | BOOL              |
| ENO     | Execution result                                                                                  | —          | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○         | ○           | ○           | ○                      | —        | ○ | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○           | —           | —                      | —        | — | —  | —      |



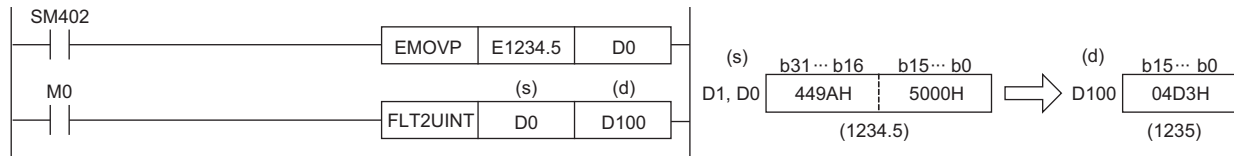
## Processing details

- These instructions convert the single-precision real number in the device specified by (s) to 16-bit unsigned binary data, and store the converted data in the device specified by (d).
- After conversion, the first digit after the decimal point of the single-precision real number is rounded off.
- When an input value is set using the engineering tool, a rounding error may occur. For the precautions on setting an input value using the engineering tool, refer to the following.

☞ Page 40 Precautions

### Ex.

When M0 turns on, the single-precision real number stored in D0 and D1 are converted to 16-bit unsigned binary data, and the converted data is stored in D100.



## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The single-precision real number in the device specified by (s) is out of the range, 0 to 65535.                                                                                                                                                                                                                                                  |
| 3282H            | An unusual number is set to (s). <ul style="list-style-type: none"> <li>• The single-precision real number set to (s) is not within the following range:<br/> <math>0, 2^{-126} \leq  (s)  &lt; 2^{128}</math></li> <li>• The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

# Converting single-precision real number to 32-bit signed binary data

## FLT2DINT(P)

These instructions convert the specified single-precision real number to 32-bit signed binary data.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=FLT2DINT(EN,s,d); ENO:=FLT2DINTP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| FLT2DINT    |                     |
| FLT2DINTP   |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                                                       | Range                     | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------|---------------------------|------------------------------|-------------------|
| (s)     | Single-precision real number or the start device where the single-precision real number is stored | -2147483648 to 2147483647 | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the converted binary data                                                | —                         | 32-bit signed binary         | ANY32_S           |
| EN      | Execution condition                                                                               | —                         | Bit                          | BOOL              |
| ENO     | Execution result                                                                                  | —                         | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

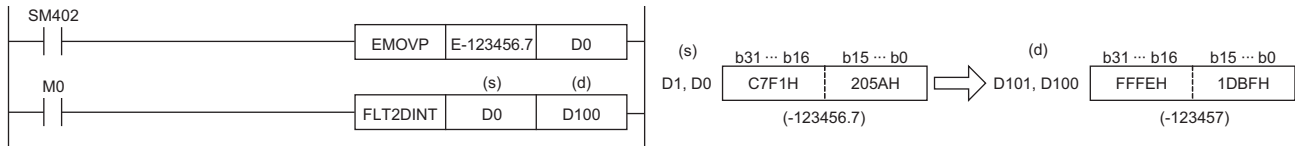
## Processing details

- These instructions convert the single-precision real number in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d).
- After conversion, the first digit after the decimal point of the single-precision real number is rounded off.
- When an input value is set using the engineering tool, a rounding error may occur. For the precautions on setting an input value using the engineering tool, refer to the following.

☞ Page 40 Precautions

### Ex.

When M0 turns on, the single-precision real number stored in D0 and D1 are converted to 32-bit signed binary data, and the converted data is stored in D100 and D101.



## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The single-precision real number in the device specified by (s) is out of the range, -2147483648 to 2147483647.                                                                                                                                                                                                                                   |
| 3282H            | An unusual number is set to (s). <ul style="list-style-type: none"> <li>• The single-precision real number set to (s) is not within the following range:<br/> <math>0, 2^{-126} \leq  (s)  &lt; 2^{128}</math></li> <li>• The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

# Converting single-precision real number to 32-bit unsigned binary data

## FLT2UDINT(P)

These instructions convert the specified single-precision real number to 32-bit unsigned binary data.

| Ladder | ST                                                          |
|--------|-------------------------------------------------------------|
|        | <pre>ENO:=FLT2UDINT(EN,s,d); ENO:=FLT2UDINTP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| FLT2UDINT   |                     |
| FLT2UDINTP  |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                                                       | Range           | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------|-----------------|------------------------------|-------------------|
| (s)     | Single-precision real number or the start device where the single-precision real number is stored | 0 to 4294967295 | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the converted binary data                                                | —               | 32-bit unsigned binary       | ANY32_U           |
| EN      | Execution condition                                                                               | —               | Bit                          | BOOL              |
| ENO     | Execution result                                                                                  | —               | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

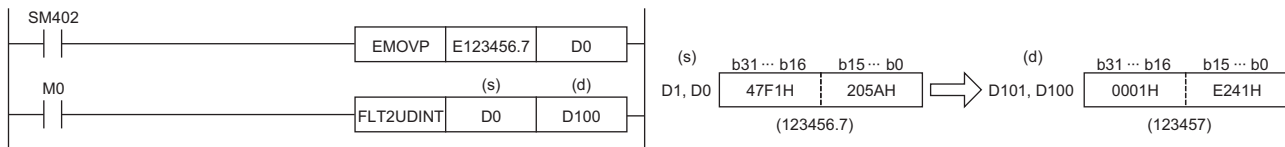
## Processing details

- These instructions convert the single-precision real number in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d).
- After conversion, the first digit after the decimal point of the single-precision real number is rounded off.
- When an input value is set using the engineering tool, a rounding error may occur. For the precautions on setting an input value using the engineering tool, refer to the following.

☞ Page 40 Precautions

### Ex.

When M0 turns on, the single-precision real number stored in D0 and D1 are converted to 32-bit unsigned binary data, and the converted data is stored in D100 and D101.



## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The single-precision real number in the device specified by (s) is out of the range, 0 to 4294967295.                                                                                                                                                                                                                                             |
| 3282H            | An unusual number is set to (s). <ul style="list-style-type: none"> <li>• The single-precision real number set to (s) is not within the following range:<br/> <math>0, 2^{-126} \leq  (s)  &lt; 2^{128}</math></li> <li>• The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

# Converting double-precision real number to 16-bit signed binary data

## DBL2INT(P)

These instructions convert the specified double-precision real number to 16-bit signed binary data.

| Ladder | ST                                                      |
|--------|---------------------------------------------------------|
|        | <pre>ENO:=DBL2INT(EN,s,d); ENO:=DBL2INTP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DBL2INT     |                     |
| DBL2INTP    |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                                                       | Range           | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------|-----------------|------------------------------|-------------------|
| (s)     | Double-precision real number or the start device where the double-precision real number is stored | -32768 to 32767 | Double-precision real number | ANYREAL_64        |
| (d)     | Device for storing the converted binary data                                                      | —               | 16-bit signed binary         | ANY16_S           |
| EN      | Execution condition                                                                               | —               | Bit                          | BOOL              |
| ENO     | Execution result                                                                                  | —               | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —         | —           | ○           | —                      | ○        | — | —  | —      |
| (d)     | ○                                | —   | ○                                     | —         | ○           | —           | —                      | ○        | — | —  | —      |

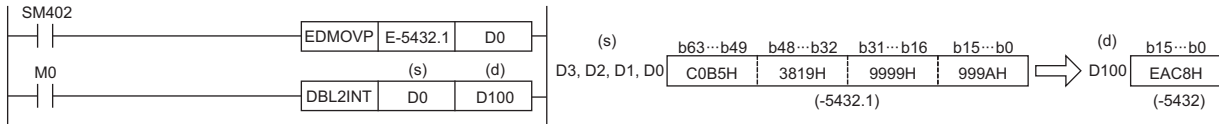
## Processing details

- These instructions convert the double-precision real number in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d).
- After conversion, the first digit after the decimal point of the double-precision real number is rounded off.
- When an input value is set using the engineering tool, a rounding error may occur. For the precautions on setting an input value using the engineering tool, refer to the following.

☞ Page 40 Precautions

### Ex.

When M0 turns on, the double-precision real number stored in D0 to D3 are converted to 16-bit signed binary data, and the converted data is stored in D100.



## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                         |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The double-precision real number in the device specified by (s) is out of the range, -32768 to 32767.                                                                                                                                                                                                                                               |
| 3282H            | An unusual number is set to (s). <ul style="list-style-type: none"> <li>• The double-precision real number set to (s) is not within the following range:<br/> <math>0, 2^{-1022} \leq  (s)  &lt; 2^{1024}</math></li> <li>• The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

# Converting double-precision real number to 16-bit unsigned binary data

## DBL2UINT(P)

These instructions convert the specified double-precision real number to 16-bit unsigned binary data.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | ENO:=DBL2UINT(EN,s,d);<br>ENO:=DBL2UINTP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DBL2UINT    |                     |
| DBL2UINTP   |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                                                       | Range      | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------|------------|------------------------------|-------------------|
| (s)     | Double-precision real number or the start device where the double-precision real number is stored | 0 to 65535 | Double-precision real number | ANYREAL_64        |
| (d)     | Device for storing the converted binary data                                                      | —          | 16-bit unsigned binary       | ANY16_U           |
| EN      | Execution condition                                                                               | —          | Bit                          | BOOL              |
| ENO     | Execution result                                                                                  | —          | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            | Z | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | ○                                | —   | ○                                     | —          | ○ | —           | —  | ○                      | —        | — | —  | —      |



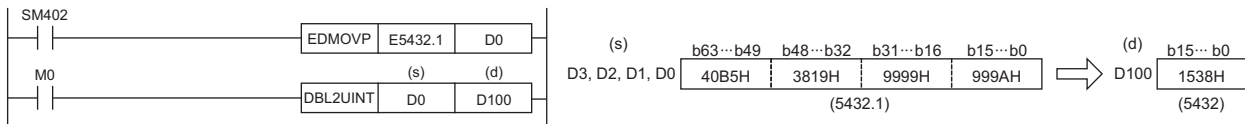
## Processing details

- These instructions convert the double-precision real number in the device specified by (s) to 16-bit unsigned binary data, and store the converted data in the device specified by (d).
- After conversion, the first digit after the decimal point of the double-precision real number is rounded off.
- When an input value is set using the engineering tool, a rounding error may occur. For the precautions on setting an input value using the engineering tool, refer to the following.

☞ Page 40 Precautions

### Ex.

When M0 turns on, the double-precision real number stored in D0 to D3 are converted to 16-bit unsigned binary data, and the converted data is stored in D100.



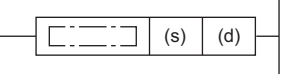
## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                         |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The double-precision real number in the device specified by (s) is out of the range, 0 to 65535.                                                                                                                                                                                                                                                    |
| 3282H            | An unusual number is set to (s). <ul style="list-style-type: none"> <li>• The double-precision real number set to (s) is not within the following range:<br/> <math>0, 2^{-1022} \leq  (s)  &lt; 2^{1024}</math></li> <li>• The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

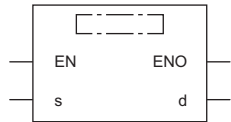
# Converting double-precision real number to 32-bit signed binary data

## DBL2DINT(P)

These instructions convert the specified double-precision real number to 32-bit signed binary data.

| Ladder                                                                            | ST                                                |
|-----------------------------------------------------------------------------------|---------------------------------------------------|
|  | ENO:=DBL2DINT(EN,s,d);<br>ENO:=DBL2DINTP(EN,s,d); |

## FBD/LD



### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DBL2DINT    |  |
| DBL2DINTP   |  |

### Setting data

### Description, range, data type

| Operand | Description                                                                                       | Range                     | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------|---------------------------|------------------------------|-------------------|
| (s)     | Double-precision real number or the start device where the double-precision real number is stored | -2147483648 to 2147483647 | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the converted binary data                                                | —                         | 32-bit signed binary         | ANY32_S           |
| EN      | Execution condition                                                                               | —                         | Bit                          | BOOL              |
| ENO     | Execution result                                                                                  | —                         | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —         | —           | ○           | —                      | ○        | — | —  | —      |
| (d)     | ○                                | —   | ○                                     | —         | ○           | ○           | ○                      | —        | — | —  | —      |

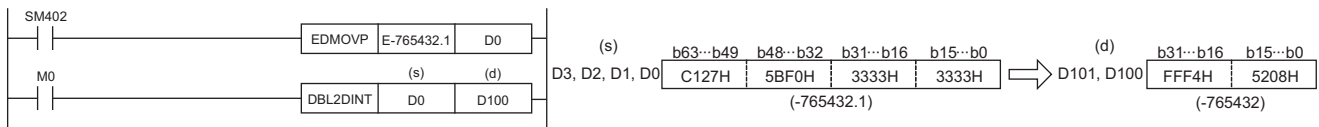
## Processing details

- These instructions convert the double-precision real number in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d).
- After conversion, the first digit after the decimal point of the double-precision real number is rounded off.
- When an input value is set using the engineering tool, a rounding error may occur. For the precautions on setting an input value using the engineering tool, refer to the following.

☞ Page 40 Precautions

### Ex.

When M0 turns on, the double-precision real number stored in D0 to D3 are converted to 32-bit signed binary data, and the converted data is stored in D100 and D101.



## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                         |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The double-precision real number in the device specified by (s) is out of the range, -2147483648 to 2147483647.                                                                                                                                                                                                                                     |
| 3282H            | An unusual number is set to (s). <ul style="list-style-type: none"> <li>• The double-precision real number set to (s) is not within the following range:<br/> <math>0, 2^{-1022} \leq  (s)  &lt; 2^{1024}</math></li> <li>• The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

# Converting double-precision real number to 32-bit unsigned binary data

## DBL2UDINT(P)

These instructions convert the specified double-precision real number to 32-bit unsigned binary data.

| Ladder | ST                                                          |
|--------|-------------------------------------------------------------|
|        | <pre>ENO:=DBL2UDINT(EN,s,d); ENO:=DBL2UDINTP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DBL2UDINT   |                     |
| DBL2UDINTP  |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                                                       | Range           | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------|-----------------|------------------------------|-------------------|
| (s)     | Double-precision real number or the start device where the double-precision real number is stored | 0 to 4294967295 | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the converted binary data                                                | —               | 32-bit unsigned binary       | ANY32_U           |
| EN      | Execution condition                                                                               | —               | Bit                          | BOOL              |
| ENO     | Execution result                                                                                  | —               | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | —           | ○           | —                      | ○        | — | —  | —      |
| (d)     | ○                                | —   | ○                                     | —          | ○           | ○           | ○                      | —        | — | —  | —      |

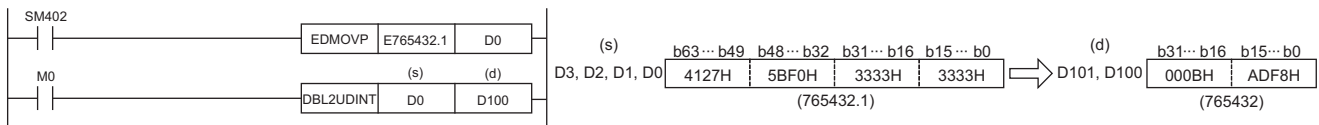
## Processing details

- These instructions convert the double-precision real number in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d).
- After conversion, the first digit after the decimal point of the double-precision real number is rounded off.
- When an input value is set using the engineering tool, a rounding error may occur. For the precautions on setting an input value using the engineering tool, refer to the following.

☞ Page 40 Precautions

### Ex.

When M0 turns on, the double-precision real number stored in D0 to D3 are converted to 32-bit unsigned binary data, and the converted data is stored in D100 and D101.



## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                         |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The double-precision real number in the device specified by (s) is out of the range, 0 to 4294967295.                                                                                                                                                                                                                                               |
| 3282H            | An unusual number is set to (s). <ul style="list-style-type: none"> <li>• The double-precision real number set to (s) is not within the following range:<br/> <math>0, 2^{-1022} \leq  (s)  &lt; 2^{1024}</math></li> <li>• The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

# Converting 16-bit signed binary data to 16-bit unsigned binary data

## INT2UINT(P)

These instructions convert the specified 16-bit signed binary data to 16-bit unsigned binary data.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=INT2UINT(EN,s,d); ENO:=INT2UINTP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| INT2UINT    |                     |
| INT2UINTP   |                     |

### Setting data

### Description, range, data type

| Operand | Description                                              | Range           | Data type              | Data type (label) |
|---------|----------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Binary data or the label where the binary data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
| (d)     | Label for storing the converted binary data              | —               | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition                                      | —               | Bit                    | BOOL              |
| ENO     | Execution result                                         | —               | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Point

The INT2UINT(P) instruction is used in programming using labels. The purpose of using this instruction is to match the data type of the specified label with the data type that can be specified by the instruction operand. In programming using devices, use of the INT2UINT(P) instruction is not required.

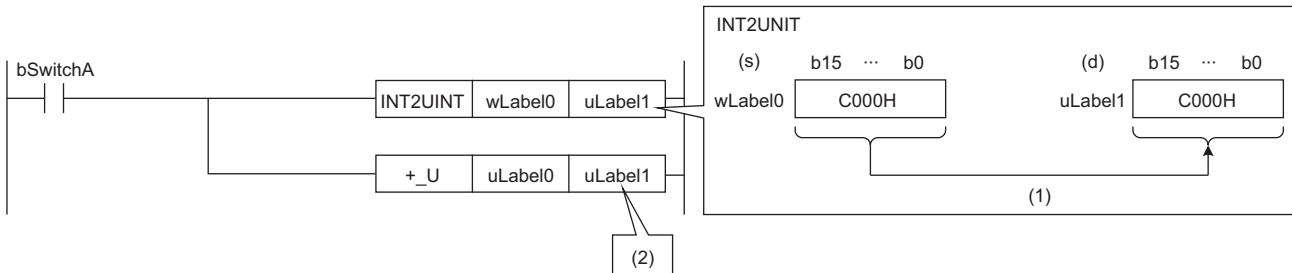
## Processing details

- These instructions convert the 16-bit signed binary data (ANY16\_S) in the label specified by (s) to 16-bit unsigned binary data (ANY16\_U), and store the converted data in the label specified by (d).
- The following figure shows a program example using the INT2UINT(P) instruction.

### Ex.

The +\_U instruction requires ANY16\_U to be specified by the operand, and therefore, before the +\_U instruction is executed, the INT2UINT instruction is used to convert wLabel0 of ANY16\_S to uLabel1 of ANY16\_U.

The value in wLabel0 is stored in uLabel1 as is.



bSwitchA: Bit

wLabel0: Word [signed]

uLabel0, uLabel1: Word [unsigned]/bit string [16 bits]

(1) The value is stored as is.

(2) The data type of the value is converted to the one of the operand in the +\_U instruction, and the operation starts.

## Operation error

There is no operation error.

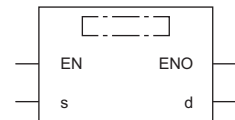
# Converting 16-bit signed binary data to 32-bit signed binary data

## INT2DINT(P)

These instructions convert the specified 16-bit signed binary data to 32-bit signed binary data.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=INT2DINT(EN,s,d); ENO:=INT2DINTP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| INT2DINT    |                     |
| INT2DINTP   |                     |

## Setting data

## Description, range, data type

| Operand | Description                                               | Range           | Data type            | Data type (label) |
|---------|-----------------------------------------------------------|-----------------|----------------------|-------------------|
| (s)     | Binary data or the device where the binary data is stored | -32768 to 32767 | 16-bit signed binary | ANY16_S           |
| (d)     | Start device for storing the converted binary data        | —               | 32-bit signed binary | ANY32_S           |
| EN      | Execution condition                                       | —               | Bit                  | BOOL              |
| ENO     | Execution result                                          | —               | Bit                  | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

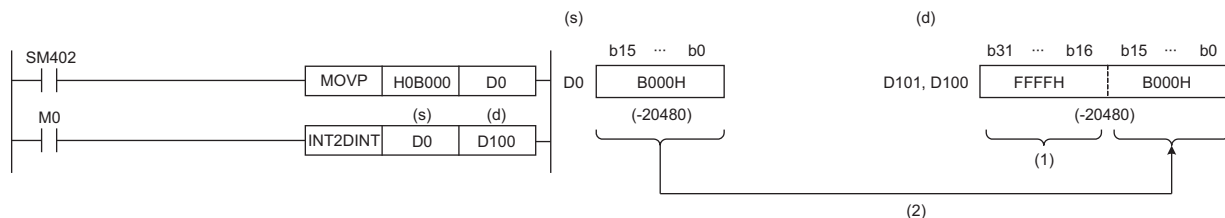


## Processing details

These instructions convert the 16-bit signed binary data in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d).

### Ex.

When M0 turns on, the 16-bit signed binary data stored in D0 is converted to 32-bit signed binary data, and the converted data is stored in D100 and D101.



(1) The most significant bit of data before conversion is stored.

(2) Stored in the lower 16 bits.

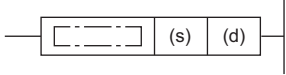
## Operation error

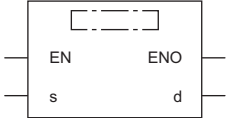
There is no operation error.

# Converting 16-bit signed binary data to 32-bit unsigned binary data

## INT2UDINT(P)

These instructions convert the specified 16-bit signed binary data to 32-bit unsigned binary data.

| Ladder                                                                            | ST                                                          |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|
|  | <pre>ENO:=INT2UDINT(EN,s,d); ENO:=INT2UDINTP(EN,s,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| INT2UDINT   |  |
| INT2UDINTP  |  |

### Setting data

### Description, range, data type

| Operand | Description                                               | Range           | Data type              | Data type (label) |
|---------|-----------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Binary data or the device where the binary data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
| (d)     | Start device for storing the converted binary data        | —               | 32-bit unsigned binary | ANY32_U           |
| EN      | Execution condition                                       | —               | Bit                    | BOOL              |
| ENO     | Execution result                                          | —               | Bit                    | BOOL              |

### Applicable devices

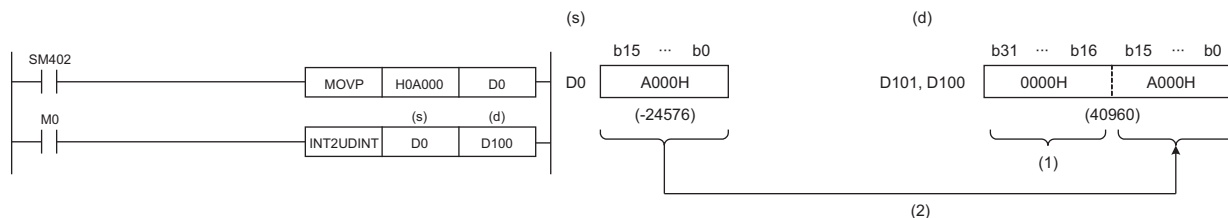
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

These instructions convert the 16-bit signed binary data in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d).

### Ex.

When M0 turns on, the 16-bit signed binary data stored in D0 is converted to 32-bit unsigned binary data, and the converted data is stored in D100 and D101.



(1) The value, 0, is stored.

(2) Stored in the lower 16 bits.

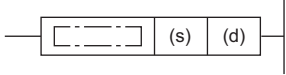
## Operation error

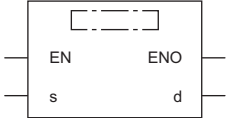
There is no operation error.

# Converting 16-bit unsigned binary data to 16-bit signed binary data

## UINT2INT(P)

These instructions convert the specified 16-bit unsigned binary data to 16-bit signed binary data.

| Ladder                                                                            | ST                                                |
|-----------------------------------------------------------------------------------|---------------------------------------------------|
|  | ENO:=UINT2INT(EN,s,d);<br>ENO:=UINT2INTP(EN,s,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| UINT2INT    |  |
| UINT2INTP   |  |

### Setting data

### Description, range, data type

| Operand | Description                                              | Range      | Data type              | Data type (label) |
|---------|----------------------------------------------------------|------------|------------------------|-------------------|
| (s)     | Binary data or the label where the binary data is stored | 0 to 65535 | 16-bit unsigned binary | ANY16_U           |
| (d)     | Label for storing the converted binary data              | —          | 16-bit signed binary   | ANY16_S           |
| EN      | Execution condition                                      | —          | Bit                    | BOOL              |
| ENO     | Execution result                                         | —          | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             | Z | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Point

The UINT2INT(P) instruction is used in programming using labels. The purpose of using this instruction is to match the data type of the specified label with the data type that can be specified by the instruction operand. In programming using devices, use of the UINT2INT(P) instruction is not required.

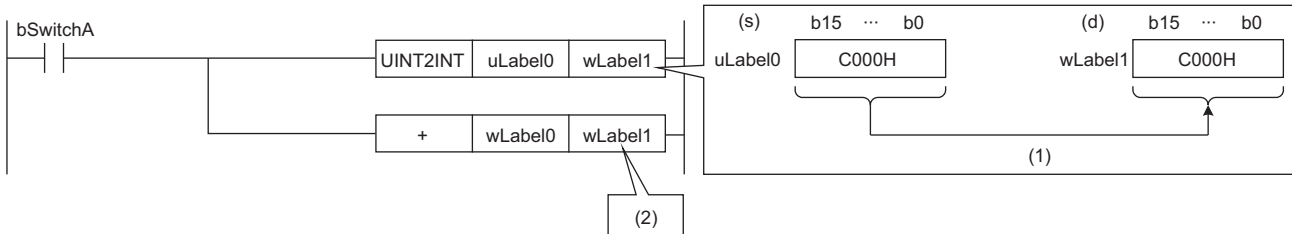
## Processing details

- These instructions convert the 16-bit signed binary data (ANY16\_U) in the label specified by (s) to 16-bit unsigned binary data (ANY16\_S), and store the converted data in the label specified by (d).
- The following figure shows a program example using the UINT2INT(P) instruction.

### Ex.

The + instruction requires ANY16\_S to be specified by the operand, and therefore, before the + instruction is executed, the UINT2INT instruction is used to convert uLabel0 of ANY16\_U to wLabel1 of ANY16\_S.

The value in uLabel0 is stored in wLabel1 as is.



bSwitchA: Bit

wLabel0, wLabel1: Word [signed]

uLabel0: Word [unsigned]/bit string [16 bits]

(1) The value is stored as is.

(2) The data type of the value is converted to the one of the operand in the + instruction, and the operation starts.

## Operation error

There is no operation error.

# Converting 16-bit unsigned binary data to 32-bit signed binary data

## UINT2DINT(P)

These instructions convert the specified 16-bit unsigned binary data to 32-bit signed binary data.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | ENO:=UINT2DINT(EN,s,d);<br>ENO:=UINT2DINTP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| UINT2DINT   |                     |
| UINT2DINTP  |                     |

### Setting data

### Description, range, data type

| Operand | Description                                               | Range      | Data type              | Data type (label) |
|---------|-----------------------------------------------------------|------------|------------------------|-------------------|
| (s)     | Binary data or the device where the binary data is stored | 0 to 65535 | 16-bit unsigned binary | ANY16_U           |
| (d)     | Start device for storing the converted binary data        | —          | 32-bit signed binary   | ANY32_S           |
| EN      | Execution condition                                       | —          | Bit                    | BOOL              |
| ENO     | Execution result                                          | —          | Bit                    | BOOL              |

### Applicable devices

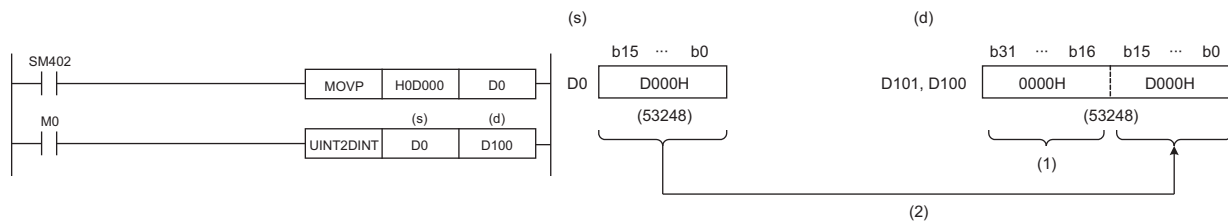
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

These instructions convert the 16-bit unsigned binary data in the device specified by (s) to 32-bit signed binary data, and store the converted data in the device specified by (d).

### Ex.

When M0 turns on, the 16-bit unsigned binary data stored in D0 is converted to 32-bit signed binary data, and the converted data is stored in D100 and D101.



(1) The value, 0, is stored.

(2) Stored in the lower 16 bits.

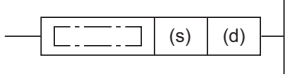
## Operation error

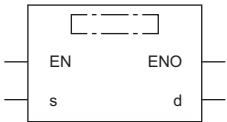
There is no operation error.

# Converting 16-bit unsigned binary data to 32-bit unsigned binary data

## UINT2UDINT(P)

These instructions convert the specified 16-bit unsigned binary data to 32-bit unsigned binary data.

| Ladder                                                                            | ST                                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------|
|  | ENO:=UINT2UDINT(EN,s,d);<br>ENO:=UINT2UDINTP(EN,s,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| UINT2UDINT  |  |
| UINT2UDINTP |  |

## Setting data

## Description, range, data type

| Operand | Description                                               | Range      | Data type              | Data type (label) |
|---------|-----------------------------------------------------------|------------|------------------------|-------------------|
| (s)     | Binary data or the device where the binary data is stored | 0 to 65535 | 16-bit unsigned binary | ANY16_U           |
| (d)     | Start device for storing the converted binary data        | —          | 32-bit unsigned binary | ANY32_U           |
| EN      | Execution condition                                       | —          | Bit                    | BOOL              |
| ENO     | Execution result                                          | —          | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

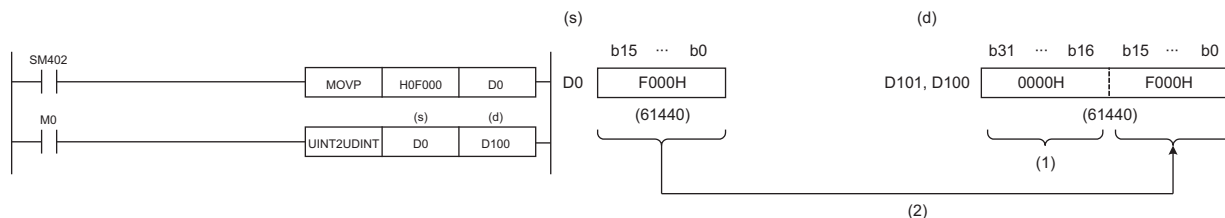


## Processing details

These instructions convert the 16-bit unsigned binary data in the device specified by (s) to 32-bit unsigned binary data, and store the converted data in the device specified by (d).

### Ex.

When M0 turns on, the 16-bit unsigned binary data stored in D0 is converted to 32-bit unsigned binary data, and the converted data is stored in D100 and D101.



- (1) The value, 0, is stored.  
 (2) Stored in the lower 16 bits.

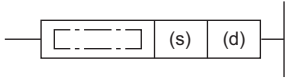
## Operation error

There is no operation error.

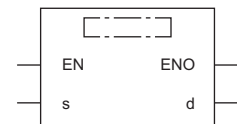
# Converting 32-bit signed binary data to 16-bit signed binary data

## DINT2INT(P)

These instructions convert the specified 32-bit signed binary data to 16-bit signed binary data.

| Ladder                                                                            | ST                                                        |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|
|  | <pre>ENO:=DINT2INT(EN,s,d); ENO:=DINT2INTP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DINT2INT    |  |
| DINT2INTP   |  |

## Setting data

## Description, range, data type

| Operand | Description                                                     | Range           | Data type            | Data type (label) |
|---------|-----------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s)     | Binary data or the start device where the binary data is stored | -32768 to 32767 | 32-bit signed binary | ANY32_S           |
| (d)     | Device for storing the converted binary data                    | —               | 16-bit signed binary | ANY16_S           |
| EN      | Execution condition                                             | —               | Bit                  | BOOL              |
| ENO     | Execution result                                                | —               | Bit                  | BOOL              |

## Applicable devices

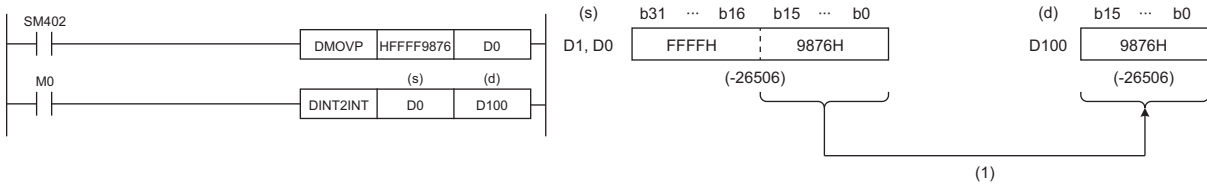
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

These instructions convert the 32-bit signed binary data in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d).

**Ex.**

When M0 turns on, the 32-bit signed binary data stored in D0 and D1 is converted to 16-bit signed binary data, and the converted data is stored in D100.



(1) Stored in the lower 16 bits.

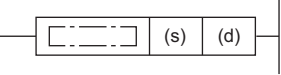
## Operation error

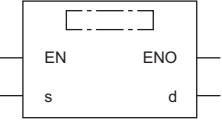
| Error code (SD0) | Description                                                                                        |
|------------------|----------------------------------------------------------------------------------------------------|
| 3281H            | The 32-bit signed binary data in the device specified by (s) is out of the range, -32768 to 32767. |

# Converting 32-bit signed binary data to 16-bit unsigned binary data

## DINT2UINT(P)

These instructions convert the specified 32-bit signed binary data to 16-bit unsigned binary data.

| Ladder                                                                            | ST                                                  |
|-----------------------------------------------------------------------------------|-----------------------------------------------------|
|  | ENO:=DINT2UINT(EN,s,d);<br>ENO:=DINT2UINTP(EN,s,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DINT2UINT   |  |
| DINT2UINTP  |  |

### Setting data

#### Description, range, data type

| Operand | Description                                                     | Range                     | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------|---------------------------|------------------------|-------------------|
| (s)     | Binary data or the start device where the binary data is stored | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
| (d)     | Device for storing the converted binary data                    | —                         | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition                                             | —                         | Bit                    | BOOL              |
| ENO     | Execution result                                                | —                         | Bit                    | BOOL              |

#### Applicable devices

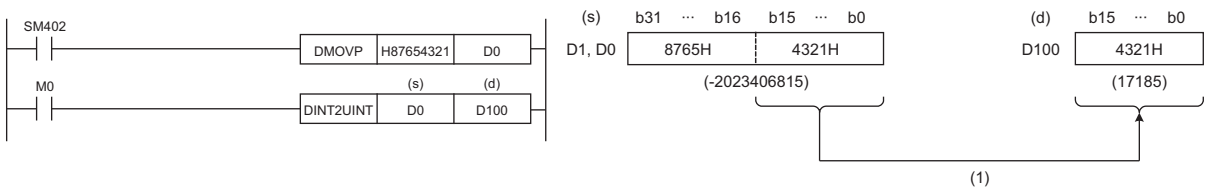
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Processing details

These instructions convert the 32-bit signed binary data in the device specified by (s) to 16-bit unsigned binary data, and store the converted data in the device specified by (d).

**Ex.**

When M0 turns on, the 32-bit signed binary data stored in D0 and D1 is converted to 16-bit unsigned binary data, and the converted data is stored in D100.



(1) Stored in the lower 16 bits.

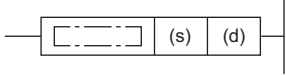
### Operation error

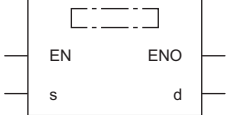
There is no operation error.

# Converting 32-bit signed binary data to 32-bit unsigned binary data

## DINT2UDINT(P)

These instructions convert the specified 32-bit signed binary data to 32-bit unsigned binary data.

| Ladder                                                                            | ST                                                            |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------|
|  | <pre>ENO:=DINT2UDINT(EN,s,d); ENO:=DINT2UDINTP(EN,s,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DINT2UDINT  |  |
| DINT2UDINTP |  |

### Setting data

### Description, range, data type

| Operand | Description                                              | Range                     | Data type              | Data type (label) |
|---------|----------------------------------------------------------|---------------------------|------------------------|-------------------|
| (s)     | Binary data or the label where the binary data is stored | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
| (d)     | Label for storing the converted binary data              | —                         | 32-bit unsigned binary | ANY32_U           |
| EN      | Execution condition                                      | —                         | Bit                    | BOOL              |
| ENO     | Execution result                                         | —                         | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Point

The DINT2UDINT(P) instruction is used in programming using labels. The purpose of using this instruction is to match the data type of the specified label with the data type that can be specified by the instruction operand.

In programming using devices, use of the DINT2UDINT(P) instruction is not required.

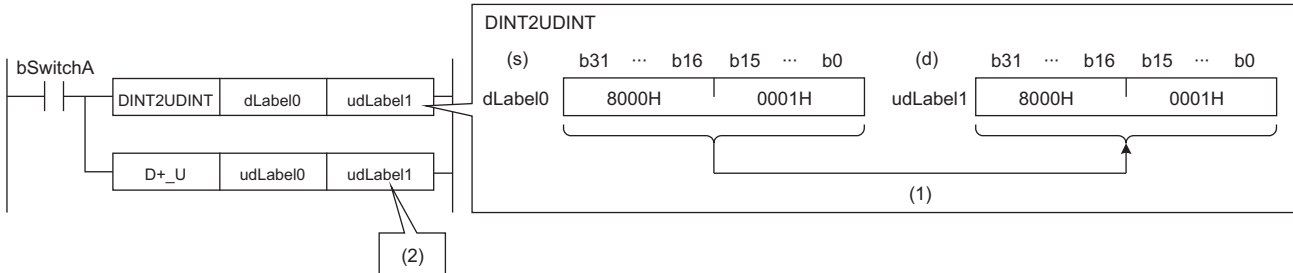
## Processing details

- These instructions convert the 32-bit signed binary data (ANY32\_S) in the label specified by (s) to 32-bit unsigned binary data (ANY32\_U), and store the converted data in the label specified by (d).
- The following figure shows a program example using the DINT2UDINT(P) instruction.

### Ex.

The D+\_U instruction requires ANY32\_U to be specified by the operand, and therefore, before the D+\_U instruction is executed, the DINT2UDINT instruction is used to convert dLabel0 of ANY32\_S to udLabel1 of ANY32\_U.

The value in dLabel0 is stored in udLabel1 as is.



bSwitchA: Bit

dLabel0: Double word [signed]

udLabel0, udLabel1: Double word [unsigned]/bit string [32 bits]

(1) The value is stored as is.

(2) The data type of the value is converted to the one of the operand in the D+\_U instruction, and the operation starts.

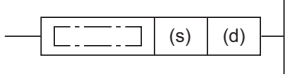
## Operation error

There is no operation error.

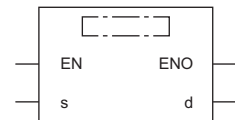
# Converting 32-bit unsigned binary data to 16-bit signed binary data

## UDINT2INT(P)

These instructions convert the specified 32-bit unsigned binary data to 16-bit signed binary data.

| Ladder                                                                            | ST                                                          |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------|
|  | <pre>ENO:=UDINT2INT(EN,s,d); ENO:=UDINT2INTP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| UDINT2INT   |  |
| UDINT2INTP  |  |

## Setting data

## Description, range, data type

| Operand | Description                                                     | Range           | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Binary data or the start device where the binary data is stored | 0 to 4294967295 | 32-bit unsigned binary | ANY32_U           |
| (d)     | Device for storing the converted binary data                    | —               | 16-bit signed binary   | ANY16_S           |
| EN      | Execution condition                                             | —               | Bit                    | BOOL              |
| ENO     | Execution result                                                | —               | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   |             | Double word |   | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|-------------|---|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ          |   |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○           | ○ | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —           | ○ | —                      | —        | — | —  | —      |

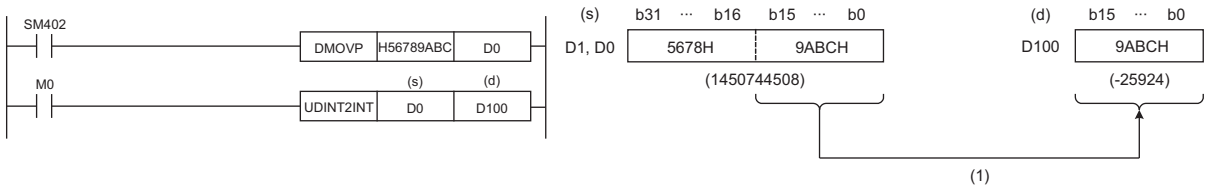


### Processing details

These instructions convert the 32-bit unsigned binary data in the device specified by (s) to 16-bit signed binary data, and store the converted data in the device specified by (d).

**Ex.**

When M0 turns on, the 32-bit unsigned binary data stored in D0 and D1 is converted to 16-bit signed binary data, and the converted data is stored in D100.



(1) Stored in the lower 16 bits.

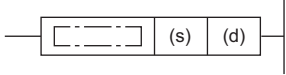
### Operation error

There is no operation error.

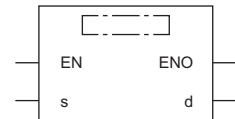
# Converting 32-bit unsigned binary data to 16-bit unsigned binary data

## UDINT2UINT(P)

These instructions convert the specified 32-bit unsigned binary data to 16-bit unsigned binary data.

| Ladder                                                                            | ST                                                            |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------|
|  | <pre>ENO:=UDINT2UINT(EN,s,d); ENO:=UDINT2UINTP(EN,s,d);</pre> |

## FBD/LD



## ■Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| UDINT2UINT  |  |
| UDINT2UINTP |  |

## Setting data

## ■Description, range, data type

| Operand | Description                                                     | Range           | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Binary data or the start device where the binary data is stored | 0 to 4294967295 | 32-bit unsigned binary | ANY32_U           |
| (d)     | Device for storing the converted binary data                    | —               | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition                                             | —               | Bit                    | BOOL              |
| ENO     | Execution result                                                | —               | Bit                    | BOOL              |

## ■Applicable devices

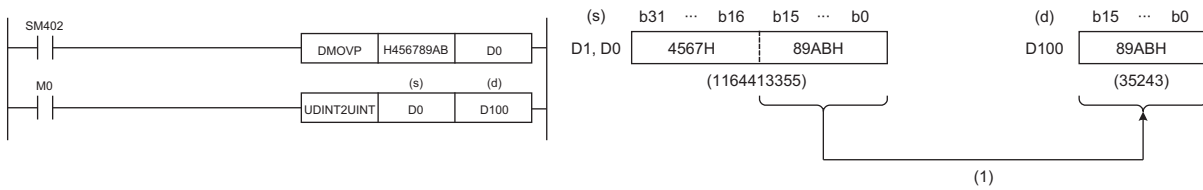
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

These instructions convert the 32-bit unsigned binary data in the device specified by (s) to 16-bit unsigned binary data, and store the converted data in the device specified by (d).

### Ex.

When M0 turns on, the 32-bit unsigned binary data stored in D0 and D1 is converted to 16-bit unsigned binary data, and the converted data is stored in D100.



(1) Stored in the lower 16 bits.

## Operation error

There is no operation error.

# Converting 32-bit unsigned binary data to 32-bit signed binary data

## UDINT2DINT(P)

These instructions convert the specified 32-bit unsigned binary data to 32-bit signed binary data.

| Ladder | ST                                                            |
|--------|---------------------------------------------------------------|
|        | <pre>ENO:=UDINT2DINT(EN,s,d); ENO:=UDINT2DINTP(EN,s,d);</pre> |
| FBD/LD |                                                               |
|        |                                                               |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| UDINT2DINT  |                     |
| UDINT2DINTP |                     |

## Setting data

## Description, range, data type

| Operand | Description                                              | Range           | Data type              | Data type (label) |
|---------|----------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Binary data or the label where the binary data is stored | 0 to 4294967295 | 32-bit unsigned binary | ANY32_U           |
| (d)     | Label for storing the converted binary data              | —               | 32-bit signed binary   | ANY32_S           |
| EN      | Execution condition                                      | —               | Bit                    | BOOL              |
| ENO     | Execution result                                         | —               | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Point

The UDINT2DINT(P) instruction is used in programming using labels. The purpose of using this instruction is to match the data type of the specified label with the data type that can be specified by the instruction operand.

In programming using devices, use of the UDINT2DINT(P) instruction is not required.

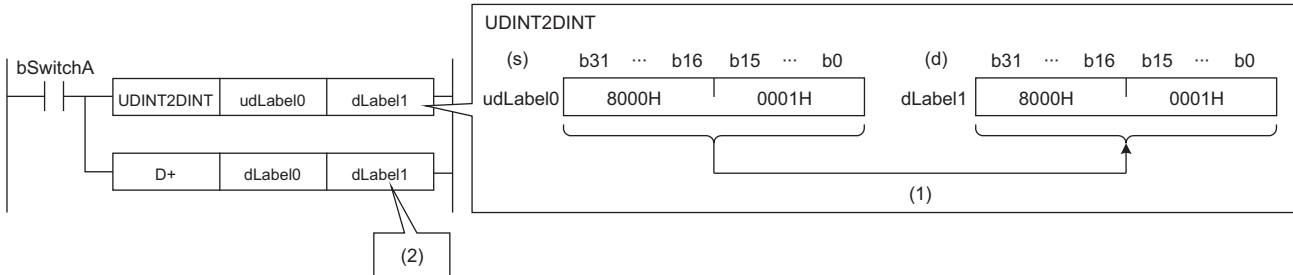
## Processing details

- These instructions convert the 32-bit signed binary data (ANY32\_U) in the label specified by (s) to 32-bit unsigned binary data (ANY32\_S), and store the converted data in the label specified by (d).
- The following figure shows a program example using the UDINT2DINT(P) instruction.

### Ex.

The D+ instruction requires ANY32\_S to be specified by the operand, and therefore, before the D+ instruction is executed, the UDINT2DINT instruction is used to convert udLabel0 of ANY32\_U to dLabel1 of ANY32\_S.

The value in udLabel0 is stored in dLabel1 as is.



bSwitchA: Bit

dLabel0, dLabel1: Double word [signed]

udLabel0: Double word [unsigned]/bit string [32 bits]

(1) The value is stored as is.

(2) The data type of the value is converted to the one of the operand in the D+ instruction, and the operation starts.

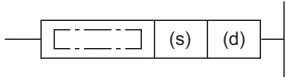
## Operation error

There is no operation error.

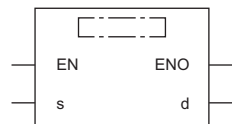
# Converting 16-bit binary data to Gray code data

## GRY(P)(\_U)

These instructions convert the specified 16-bit binary data to 16-bit binary Gray code data.

| Ladder                                                                            | ST                                      |                                             |
|-----------------------------------------------------------------------------------|-----------------------------------------|---------------------------------------------|
|  | ENO:=GRY(EN,s,d);<br>ENO:=GRYP(EN,s,d); | ENO:=GRY_U(EN,s,d);<br>ENO:=GRYP_U(EN,s,d); |

## FBD/LD



## Execution condition

| Instruction    | Execution condition                                                               |
|----------------|-----------------------------------------------------------------------------------|
| GRY<br>GRY_U   |  |
| GRYP<br>GRYP_U |  |

## Setting data

## Description, range, data type

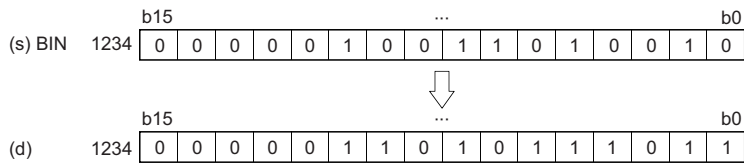
| Operand | Description         | Range      | Data type              | Data type (label) |
|---------|---------------------|------------|------------------------|-------------------|
| (s)     | GRY(P)              | 0 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | GRY(P)_U            | 0 to 65535 | 16-bit unsigned binary | ANY16_U           |
| (d)     | GRY(P)              | —          | 16-bit signed binary   | ANY16_S           |
|         | GRY(P)_U            | —          | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition | —          | Bit                    | BOOL              |
| ENO     | Execution result    | —          | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              | Word |                                       |             | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□  | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○           | —           | —                      | ○        | ○ | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○           | —           | —                      | ○        | — | —  | —      |

## Processing details

These instructions convert the 16-bit binary data in the device specified by (s) to 16-bit binary Gray code data, and store the converted data in the device specified by (d).



## Operation error

| Error code (SD0) | Description                                                                                                    |
|------------------|----------------------------------------------------------------------------------------------------------------|
| 3281H            | When the GRY(P) instruction is used, the value in the device specified by (s) is out of the range, 0 to 32767. |

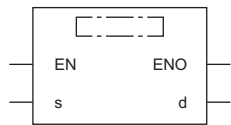
# Converting 32-bit binary data to Gray code data

## DGRY(P)(\_U)

These instructions convert the specified 32-bit binary data to 32-bit binary Gray code data.

| Ladder | ST                                        |                                               |
|--------|-------------------------------------------|-----------------------------------------------|
|        | ENO:=DGRY(EN,s,d);<br>ENO:=DGRYP(EN,s,d); | ENO:=DGRY_U(EN,s,d);<br>ENO:=DGRYP_U(EN,s,d); |

### FBD/LD



### Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| DGRY<br>DGRY_U   |                     |
| DGRYP<br>DGRYP_U |                     |

### Setting data

### Description, range, data type

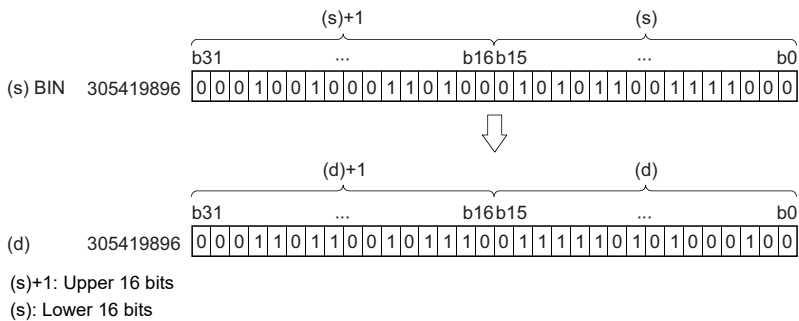
| Operand | Description                                                     | Range           | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Binary data or the start device where the binary data is stored | 0 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         |                                                                 | 0 to 4294967295 | 32-bit unsigned binary | ANY32_U           |
| (d)     | Start device for storing the converted Gray code data           | —               | 32-bit signed binary   | ANY32_S           |
|         |                                                                 |                 | 32-bit unsigned binary | ANY32_U           |
| EN      | Execution condition                                             | —               | Bit                    | BOOL              |
| ENO     | Execution result                                                | —               | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

These instructions convert the 32-bit binary data in the device specified by (s) to 32-bit binary Gray code data, and store the converted data in the device specified by (d).



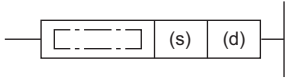


| Error code (SD0) | Description                                                                                                          |
|------------------|----------------------------------------------------------------------------------------------------------------------|
| 3281H            | When the DGRY(P) instruction is used, the value in the device specified by (s) is out of the range, 0 to 2147483647. |

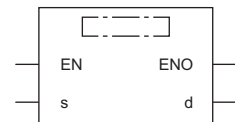
# Converting 16-bit binary Gray code data to 16-bit binary data

## GBIN(P)(\_U)

These instructions convert the specified 16-bit binary Gray code data to 16-bit binary data.

| Ladder                                                                            | ST                                        |                                               |
|-----------------------------------------------------------------------------------|-------------------------------------------|-----------------------------------------------|
|  | ENO:=GBIN(EN,s,d);<br>ENO:=GBINP(EN,s,d); | ENO:=GBIN_U(EN,s,d);<br>ENO:=GBINP_U(EN,s,d); |

## FBD/LD



## Execution condition

| Instruction      | Execution condition                                                               |
|------------------|-----------------------------------------------------------------------------------|
| GBIN<br>GBIN_U   |  |
| GBINP<br>GBINP_U |  |

## Setting data

## Description, range, data type

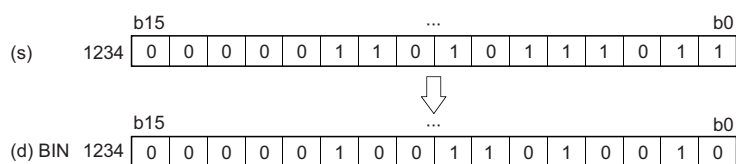
| Operand |           | Description                                                     | Range      | Data type              | Data type (label) |
|---------|-----------|-----------------------------------------------------------------|------------|------------------------|-------------------|
| (s)     | GBIN(P)   | Gray code data or the device where the Gray code data is stored | 0 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | GBIN(P)_U |                                                                 | 0 to 65535 | 16-bit unsigned binary | ANY16_U           |
| (d)     | GBIN(P)   | Device for storing the converted binary data                    | —          | 16-bit signed binary   | ANY16_S           |
|         | GBIN(P)_U |                                                                 |            | 16-bit unsigned binary | ANY16_U           |
| EN      |           | Execution condition                                             | —          | Bit                    | BOOL              |
| ENO     |           | Execution result                                                | —          | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |           | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○         | ○           | —           | —                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○           | —           | —                      | ○        | — | —  | —      |

## Processing details

These instructions convert the 16-bit binary Gray code data in the device specified by (s) to 16-bit binary data, and store the converted data in the device specified by (d).

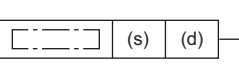


| Error code (SD0) | Description                                                                                                     |
|------------------|-----------------------------------------------------------------------------------------------------------------|
| 3281H            | When the GBIN(P) instruction is used, the value in the device specified by (s) is out of the range, 0 to 32767. |

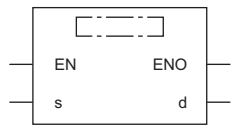
# Converting 32-bit binary Gray code data to 32-bit binary data

## DGBIN(P)(\_U)

These instructions convert the specified 32-bit binary Gray code data to 32-bit binary data.

| Ladder                                                                            | ST                                          |                                                 |
|-----------------------------------------------------------------------------------|---------------------------------------------|-------------------------------------------------|
|  | ENO:=DGBIN(EN,s,d);<br>ENO:=DGBINP(EN,s,d); | ENO:=DGBIN_U(EN,s,d);<br>ENO:=DGBINP_U(EN,s,d); |

### FBD/LD



### Execution condition

| Instruction        | Execution condition                                                               |
|--------------------|-----------------------------------------------------------------------------------|
| DGBIN<br>DGBIN_U   |  |
| DGBINP<br>DGBINP_U |  |

### Setting data

### Description, range, data type

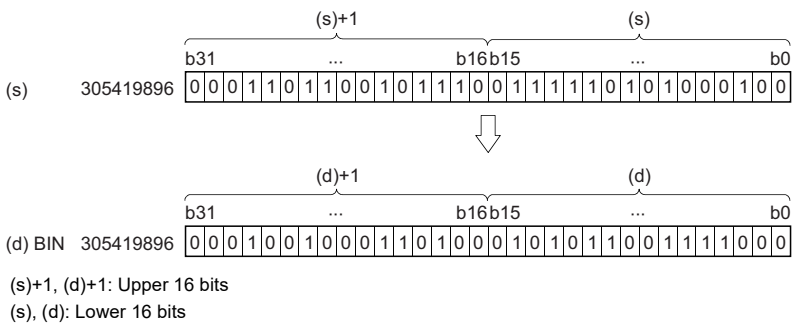
| Operand |            | Description                                                           | Range           | Data type              | Data type (label) |
|---------|------------|-----------------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | DGBIN(P)   | Gray code data or the start device where the Gray code data is stored | 0 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | DGBIN(P)_U |                                                                       | 0 to 4294967295 | 32-bit unsigned binary | ANY32_U           |
| (d)     | DGBIN(P)   | Start device for storing the converted binary data                    | —               | 32-bit signed binary   | ANY32_S           |
|         | DGBIN(P)_U |                                                                       |                 | 32-bit unsigned binary | ANY32_U           |
| EN      |            | Execution condition                                                   | —               | Bit                    | BOOL              |
| ENO     |            | Execution result                                                      | —               | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

These instructions convert the 32-bit binary Gray code data in the device specified by (s) to 32-bit binary data, and store the converted data in the device specified by (d).

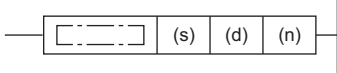


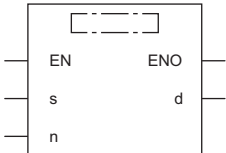
| Error code (SD0) | Description                                                                                                           |
|------------------|-----------------------------------------------------------------------------------------------------------------------|
| 3281H            | When the DGBIN(P) instruction is used, the value in the device specified by (s) is out of the range, 0 to 2147483647. |

# Converting 16-bit binary data block to BCD 4-digit data block

## BKBCD(P)

These instructions convert (n) points of binary data (0 to 9999) starting from the specified device to BCD data.

| Ladder                                                                            | ST                                              |
|-----------------------------------------------------------------------------------|-------------------------------------------------|
|  | ENO:=BKBCD(EN,s,n,d);<br>ENO:=BKBCDP(EN,s,n,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| BKBCD       |  |
| BKBCDP      |  |

## Setting data

## Description, range, data type

| Operand | Description                                     | Range      | Data type              | Data type (label) |
|---------|-------------------------------------------------|------------|------------------------|-------------------|
| (s)     | Start device where the binary data is stored    | —          | 16-bit signed binary   | ANY16*1           |
| (d)     | Start device for storing the converted BCD data | —          | BCD 4-digit            | ANY16*1           |
| (n)     | Number of variables                             | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition                             | —          | Bit                    | BOOL              |
| ENO     | Execution result                                | —          | Bit                    | BOOL              |

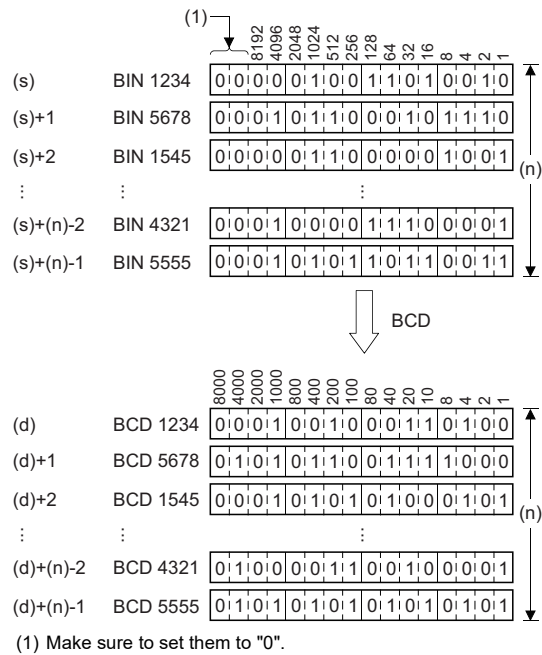
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |      | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

These instructions convert the (n) points of 16-bit binary data (0 to 9999) starting from the device specified by (s) to BCD data, and store the converted data in the device specified by (d) and later.



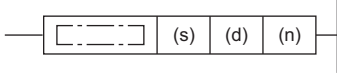
## Operation error

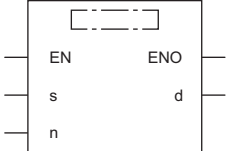
| Error code (SD0) | Description                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------|
| 2821H            | The device ranges specified by (s) and (d) are overlapping.                                      |
| 3281H            | The (n) points of data starting from the device specified by (s) is out of the range, 0 to 9999. |

# Converting BCD 4-digit block data to 16-bit binary block data

## BKBIN(P)

These instructions convert (n) points of BCD data (0 to 9999) starting from the specified device to binary data.

| Ladder                                                                            | ST                                                      |
|-----------------------------------------------------------------------------------|---------------------------------------------------------|
|  | <pre>ENO:=BKBIN(EN,s,n,d); ENO:=BKBINP(EN,s,n,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| BKBIN       |  |
| BKBINP      |  |

## Setting data

## Description, range, data type

| Operand | Description                                        | Range      | Data type              | Data type (label)   |
|---------|----------------------------------------------------|------------|------------------------|---------------------|
| (s)     | Start device where the BCD data is stored          | —          | BCD 4-digit            | ANY16 <sup>*1</sup> |
| (d)     | Start device for storing the converted binary data | —          | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (n)     | Number of variables                                | 0 to 65535 | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                | —          | Bit                    | BOOL                |
| ENO     | Execution result                                   | —          | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

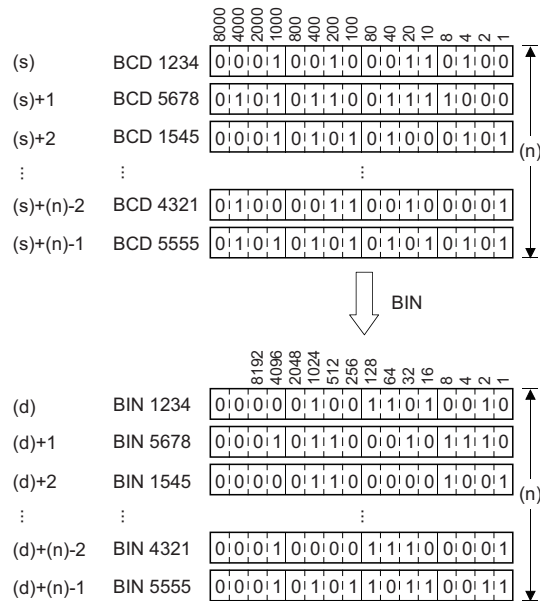
## Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |



## Processing details

These instructions convert the (n) points of BCD data (0 to 9999) starting from the device specified by (s) to 16-bit binary data, and store the converted data in the device specified by (d) and later.



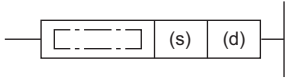
## Operation error

| Error code (SD0) | Description                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------|
| 2821H            | The device ranges specified by (s) and (d) are overlapping.                                      |
| 3281H            | The (n) points of data starting from the device specified by (s) is out of the range, 0 to 9999. |

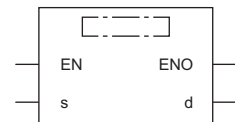
# Converting decimal ASCII data to 16-bit binary data

## DABIN(P)(\_U)

These instructions convert decimal ASCII data to 16-bit binary data.

| Ladder                                                                            | ST                                          |                                                 |
|-----------------------------------------------------------------------------------|---------------------------------------------|-------------------------------------------------|
|  | ENO:=DABIN(EN,s,d);<br>ENO:=DABINP(EN,s,d); | ENO:=DABIN_U(EN,s,d);<br>ENO:=DABINP_U(EN,s,d); |

### FBD/LD



## Execution condition

| Instruction        | Execution condition                                                               |
|--------------------|-----------------------------------------------------------------------------------|
| DABIN<br>DABIN_U   |  |
| DABINP<br>DABINP_U |  |

## Setting data

## Description, range, data type

| Operand | Description                                                                                  | Range | Data type              | Data type (label) |
|---------|----------------------------------------------------------------------------------------------|-------|------------------------|-------------------|
| (s)     | ASCII data to be converted to binary data or the start device where the ASCII data is stored | —     | String                 | ANYSTRING_SINGLE  |
| (d)     | Device for storing the converted binary data                                                 | —     | 16-bit signed binary   | ANY16_S           |
|         |                                                                                              |       | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition                                                                          | —     | Bit                    | BOOL              |
| ENO     | Execution result                                                                             | —     | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

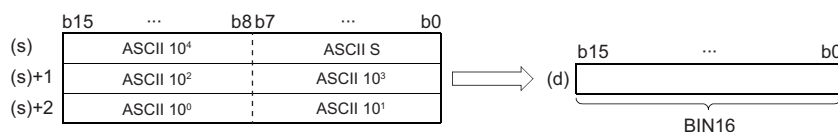
## Processing details

- These instructions convert the decimal ASCII data in the device specified by (s) and later to 16-bit binary data, and store the converted data in the device specified by (d).
- The setting method of the decimal ASCII data to be set in (s) depends on the status of SM705 (Number of conversion digits selection).

| Status of SM705 | Setting method of (s)                                                                     | Reference                                                                                    |
|-----------------|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Off             | Set (s) with a fixed number of digits (a sign + 5 digits in the numeric part).            | Page 453 Setting method of (s) for when SM705 (Number of conversion digits selection) is off |
| On              | Set (s) with a desired number of digits (maximum: a sign + 5 digits in the numeric part). | Page 454 Setting method of (s) for when SM705 (Number of conversion digits selection) is on  |

### ■Setting method of (s) for when SM705 (Number of conversion digits selection) is off

Set decimal ASCII data with the fixed number of digits in (s) to (s)+2.



ASCII S: Sign data of ASCII code

ASCII 10<sup>4</sup>: Ten-thousands place of ASCII code

ASCII 10<sup>3</sup>: Thousands place of ASCII code

ASCII 10<sup>2</sup>: Hundreds place of ASCII code

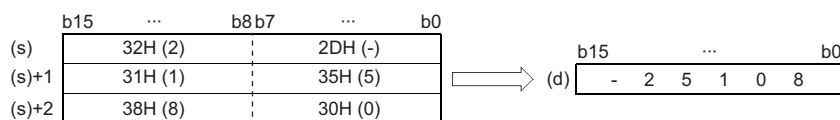
ASCII 10<sup>1</sup>: Tens place of ASCII code

ASCII 10<sup>0</sup>: Ones place of ASCII code

- The ASCII data in the device specified by (s) to (s)+2 is within the range from -32768 to 32767 for the DABIN(P) instruction, and it is within the range from 0 to 65535 for the DABIN(P)\_U instruction.
- The data of (s)+3 or later is ignored.
- As sign data, set 20H (space) when the ASCII data is positive, and set 2DH (-) when the data is negative. (If a value other than 20H and 2DH is set, the data will be processed as positive data.)
- A value from 30H to 39H can be set in each place of ASCII code.
- If a value 20H or 00H is set in each place of ASCII code, the value will be processed as 30H.

#### Ex.

"-25108" is set in (s) when the DABIN(P) instruction is used



## ■Setting method of (s) for when SM705 (Number of conversion digits selection) is on

Set decimal ASCII data with a desired number of digits (including 00H (NULL code)) in (s). Note that 00H (NULL code) is not required to be set if the integral part has the maximum number of digits (5 digits).

The following table lists the setting method of (s).

| Value to be set in (s)                                                                                 | Data of (s) to (s)+2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Value to be set in (s) | Data of (s) to (s)+2            |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------------|-------|-----|----|-----|-----------------------|--|-----------------------|--|-------|-----------------------|--|-----------------------|--|-------|-----------------------|--|-----------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-----|----|-----|-----------------------|--|---------------------------------|--|-------|-----------------------|--|-----------------------|--|-------|--|--|-----------------------|--|
| <ul style="list-style-type: none"><li>• 0</li><li>• Positive value (1 digit in numeric part)</li></ul> | <ul style="list-style-type: none"><li>• Set 00H in the upper byte of (s).</li><li>• The data of (s)+1 or later is ignored.</li></ul> <table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td colspan="2">00H</td><td colspan="2">ASCII 10<sup>0</sup></td></tr><tr><td>(s)+1</td><td colspan="4"></td></tr><tr><td>(s)+2</td><td colspan="4"></td></tr></table>                                                                                                           | b15                    | ...                             | b8 b7 | ... | b0 | (s) | 00H                   |  | ASCII 10 <sup>0</sup> |  | (s)+1 |                       |  |                       |  | (s)+2 |                       |  |                       |  | <ul style="list-style-type: none"><li>• Positive value (2 digits in numeric part)</li><li>• Negative value (1 digit in numeric part)</li></ul>                         | <ul style="list-style-type: none"><li>• Set 00H in the lower byte of (s)+1.</li><li>• The data of the upper byte of (s)+1 or later is ignored.</li></ul> <table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td colspan="2">ASCII 10<sup>0</sup></td><td colspan="2">ASCII 10<sup>1</sup> / 2DH (-)</td></tr><tr><td>(s)+1</td><td colspan="2"></td><td colspan="2">00H</td></tr><tr><td>(s)+2</td><td colspan="4"></td></tr></table>                                               | b15 | ... | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>0</sup> |  | ASCII 10 <sup>1</sup> / 2DH (-) |  | (s)+1 |                       |  | 00H                   |  | (s)+2 |  |  |                       |  |
| b15                                                                                                    | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | b8 b7                  | ...                             | b0    |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)                                                                                                    | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                        | ASCII 10 <sup>0</sup>           |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)+1                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                        |                                 |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)+2                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                        |                                 |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| b15                                                                                                    | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | b8 b7                  | ...                             | b0    |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)                                                                                                    | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        | ASCII 10 <sup>1</sup> / 2DH (-) |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)+1                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                        | 00H                             |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)+2                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                        |                                 |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| ⋮                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                        |                                 |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| Negative value (4 digits in numeric part)                                                              | Set 00H in the upper byte of (s)+2. <table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td colspan="2">ASCII 10<sup>3</sup></td><td colspan="2">2DH (-)</td></tr><tr><td>(s)+1</td><td colspan="2">ASCII 10<sup>1</sup></td><td colspan="2">ASCII 10<sup>2</sup></td></tr><tr><td>(s)+2</td><td colspan="2">00H</td><td colspan="2">ASCII 10<sup>0</sup></td></tr></table>                                                                                               | b15                    | ...                             | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>3</sup> |  | 2DH (-)               |  | (s)+1 | ASCII 10 <sup>1</sup> |  | ASCII 10 <sup>2</sup> |  | (s)+2 | 00H                   |  | ASCII 10 <sup>0</sup> |  | Positive value (5 digits in numeric part)                                                                                                                              | The data of the upper byte of (s)+2 or later is ignored. Since the number of digits is the maximum, 00H is not required to be set. <table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td colspan="2">ASCII 10<sup>3</sup></td><td colspan="2">ASCII 10<sup>4</sup></td></tr><tr><td>(s)+1</td><td colspan="2">ASCII 10<sup>1</sup></td><td colspan="2">ASCII 10<sup>2</sup></td></tr><tr><td>(s)+2</td><td colspan="2"></td><td colspan="2">ASCII 10<sup>0</sup></td></tr></table> | b15 | ... | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>3</sup> |  | ASCII 10 <sup>4</sup>           |  | (s)+1 | ASCII 10 <sup>1</sup> |  | ASCII 10 <sup>2</sup> |  | (s)+2 |  |  | ASCII 10 <sup>0</sup> |  |
| b15                                                                                                    | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | b8 b7                  | ...                             | b0    |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)                                                                                                    | ASCII 10 <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        | 2DH (-)                         |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)+1                                                                                                  | ASCII 10 <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        | ASCII 10 <sup>2</sup>           |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)+2                                                                                                  | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                        | ASCII 10 <sup>0</sup>           |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| b15                                                                                                    | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | b8 b7                  | ...                             | b0    |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)                                                                                                    | ASCII 10 <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        | ASCII 10 <sup>4</sup>           |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)+1                                                                                                  | ASCII 10 <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        | ASCII 10 <sup>2</sup>           |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)+2                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                        | ASCII 10 <sup>0</sup>           |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| Negative value (5 digits in numeric part)                                                              | The data of (s)+3 or later is ignored. Since the number of digits is the maximum, 00H is not required to be set. <table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td colspan="2">ASCII 10<sup>4</sup></td><td colspan="2">2DH (-)</td></tr><tr><td>(s)+1</td><td colspan="2">ASCII 10<sup>2</sup></td><td colspan="2">ASCII 10<sup>3</sup></td></tr><tr><td>(s)+2</td><td colspan="2">ASCII 10<sup>0</sup></td><td colspan="2">ASCII 10<sup>1</sup></td></tr></table> | b15                    | ...                             | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>4</sup> |  | 2DH (-)               |  | (s)+1 | ASCII 10 <sup>2</sup> |  | ASCII 10 <sup>3</sup> |  | (s)+2 | ASCII 10 <sup>0</sup> |  | ASCII 10 <sup>1</sup> |  | ASCII 10 <sup>0</sup> : Ones place of ASCII code<br>ASCII 10 <sup>1</sup> : Tens place of ASCII code<br>⋮<br>ASCII 10 <sup>4</sup> : Ten-thousands place of ASCII code |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| b15                                                                                                    | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | b8 b7                  | ...                             | b0    |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)                                                                                                    | ASCII 10 <sup>4</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        | 2DH (-)                         |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)+1                                                                                                  | ASCII 10 <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        | ASCII 10 <sup>3</sup>           |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |
| (s)+2                                                                                                  | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        | ASCII 10 <sup>1</sup>           |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |       |     |    |     |                       |  |                                 |  |       |                       |  |                       |  |       |  |  |                       |  |

- The ASCII data in the device specified by (s) to (s)+2 is within the range from -32768 to 32767 for the DABIN(P) instruction, and it is within the range from 0 to 65535 for the DABIN(P)\_U instruction.
- Set 2DH (-) to lower byte of (s)+0 as sign data when the ASCII data is negative. Set an ASCII code of the uppermost digit instead of setting sign data when the ASCII data is 0 or positive.
- A value from 30H to 39H can be set in each place of ASCII code.
- If the value is positive and the numeric part has 5 digits, the data of the upper byte of (s)+2 or later is ignored. If the value is negative and the numeric part has 5 digits, the data of (s)+3 or later is ignored.
- If a value 20H is set in each place of ASCII code, the value is processed as 30H. If a value 00H is set, the value is processed as the end of the decimal ASCII data.
- In the following cases, 0 is stored.
  - The first character is 00H (NULL).
  - The first character is 2DH (-) and the second character is 00H (NULL).

## Operation error

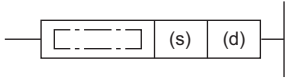
| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | Invalid data that cannot be converted are input in (s) to (s)+2. <ul style="list-style-type: none"> <li>The ASCII code of the first character is other than 2DH, 30H to 39H, 20H, and 00H.*1</li> <li>The ASCII code of the second character or later is other than 30H to 39H, 20H, and 00H.</li> <li>When the DABIN(P) instruction is used, ASCII data is out of the range from -32768 to 32767.</li> <li>When the DABIN(P)_U instruction is used, ASCII data is out of the range from 0 to 65535.</li> </ul> |

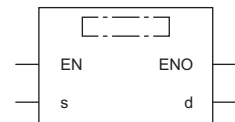
\*1 When SM705 (Number of conversion digits selection) is off, no error is detected no matter what value is set for the ASCII code of the first character.

# Converting decimal ASCII data to 32-bit binary data

## DDABIN(P)(\_U)

These instructions convert decimal ASCII data to 32-bit binary data.

| Ladder                                                                            | ST                                            |                                                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------------------|
|  | ENO:=DDABIN(EN,s,d);<br>ENO:=DDABINP(EN,s,d); | ENO:=DDABIN_U(EN,s,d);<br>ENO:=DDABINP_U(EN,s,d); |
| FBD/LD                                                                            |                                               |                                                   |



### Execution condition

| Instruction          | Execution condition                                                               |
|----------------------|-----------------------------------------------------------------------------------|
| DDABIN<br>DDABIN_U   |  |
| DDABINP<br>DDABINP_U |  |

### Setting data

### Description, range, data type

| Operand | Description                                                                                  | Range | Data type              | Data type (label) |
|---------|----------------------------------------------------------------------------------------------|-------|------------------------|-------------------|
| (s)     | ASCII data to be converted to binary data or the start device where the ASCII data is stored | —     | String                 | ANYSTRING_SINGLE  |
| (d)     | Start device for storing the conversion result                                               | —     | 32-bit signed binary   | ANY32_S           |
|         |                                                                                              |       | 32-bit unsigned binary | ANY32_U           |
| EN      | Execution condition                                                                          | —     | Bit                    | BOOL              |
| ENO     | Execution result                                                                             | —     | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

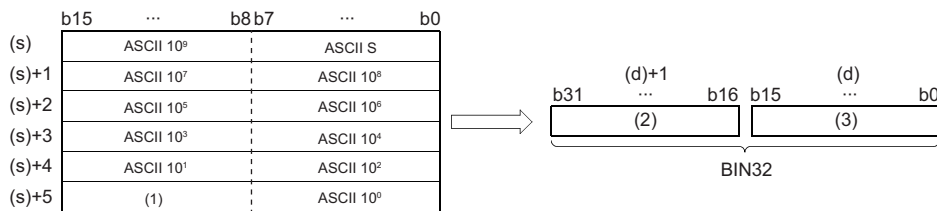
## Processing details

- These instructions convert the decimal ASCII data in the device areas specified by (s) and later to 32-bit binary data, and store the converted data in the device specified by (d).
- The setting method of the decimal ASCII data to be set in (s) depends on the status of SM705 (Number of conversion digits selection).

| Status of SM705 | Setting method of (s)                                                                      | Reference                                                                                    |
|-----------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Off             | Set (s) with a fixed number of digits (a sign + 10 digits in the numeric part).            | Page 456 Setting method of (s) for when SM705 (Number of conversion digits selection) is off |
| On              | Set (s) with a desired number of digits (maximum: a sign + 10 digits in the numeric part). | Page 457 Setting method of (s) for when SM705 (Number of conversion digits selection) is on  |

### ■ Setting method of (s) for when SM705 (Number of conversion digits selection) is off

Set decimal ASCII data with the fixed number of digits in (s) to (s)+5.



ASCII S: Sign data of ASCII code

ASCII 10<sup>0</sup>: Ones place of ASCII code

ASCII 10<sup>1</sup>: Tens place of ASCII code

ASCII 10<sup>2</sup>: Hundreds place of ASCII code

ASCII 10<sup>3</sup>: Thousands place of ASCII code

ASCII 10<sup>4</sup>: Ten-thousands place of ASCII code

ASCII 10<sup>5</sup>: Hundred-thousands place of ASCII code

ASCII 10<sup>6</sup>: Millions place of ASCII code

ASCII 10<sup>7</sup>: Ten-millions place of ASCII code

ASCII 10<sup>8</sup>: Hundred-millions place of ASCII code

ASCII 10<sup>9</sup>: Billions place of ASCII code

(1) Ignored.

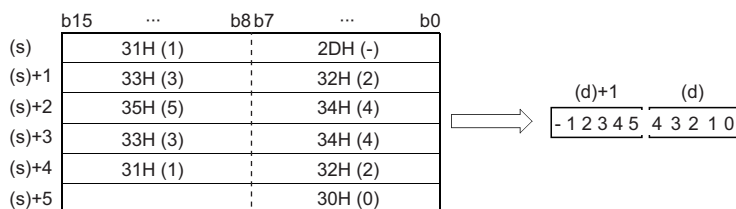
(2) Upper 16 bits

(3) Lower 16 bits

- The ASCII data in the device specified by (s) to (s)+5 is within the range from -2147483648 to 2147483647 for the DDABIN(P) instruction, and it is within the range from 0 to 4294967295 for the DDABIN(P)\_U instruction. Any data stored in the upper bytes in the device specified by (s)+5 and data in the device specified by (s)+6 and later are ignored.
- As sign data, set 20H if the ASCII data is positive, and set 2DH if the data is negative. (If a value other than 20H and 2DH is set, the data will be processed as positive data.)
- A value from 30H to 39H can be set in each place of ASCII code.
- If a value 20H or 00H is set in each place of ASCII code, the value will be processed as 30H.

#### Ex.

"-1234543210" is set in (s) when the DDABIN(P) instruction is used



## ■Setting method of (s) for when SM705 (Number of conversion digits selection) is on

Set decimal ASCII data with a desired number of digits (including 00H (NULL code)) in (s). Note that 00H (NULL code) is not required to be set if the integral part has the maximum number of digits (10 digits).

The following table lists the setting method of (s).

| Value to be set in (s)                                                                                                                          | Data of (s) to (s)+5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Value to be set in (s) | Data of (s) to (s)+5            |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------------|-----|-------|-----|----|-----|-----------------------|--|---------------------------------|--|--|-------|-----------------------|--|-----------------------|--|--|-------|-----------------------|--|-----------------------|--|--|-------|-----------------------|--|-----------------------|--|--|-------|-----------------------|--|-----------------------|--|--|-------|--|--|--|--|--|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----|-----|-------|-----|----|-----|-----------------------|--|---------------------------------|--|--|-------|-----------------------|--|-----------------------|--|--|-------|-----------------------|--|-----------------------|--|--|-------|-----------------------|--|-----------------------|--|--|-------|-----------------------|--|-----------------------|--|--|-------|--|--|-----------------------|--|--|
| <ul style="list-style-type: none"><li>• 0</li><li>• Positive value (1 digit in numeric part)</li></ul>                                          | <ul style="list-style-type: none"><li>• Set 00H in the upper byte of (s).</li><li>• The data of (s)+1 or later is ignored.</li></ul> <table><tr><td></td><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td colspan="2">00H</td><td colspan="2">ASCII 10<sup>0</sup></td><td></td></tr><tr><td>(s)+1</td><td colspan="5"></td></tr><tr><td>(s)+2</td><td colspan="5"></td></tr><tr><td>(s)+3</td><td colspan="5"></td></tr><tr><td>(s)+4</td><td colspan="5"></td></tr><tr><td>(s)+5</td><td colspan="5"></td></tr></table>                                                                                                                                                                                                                                                                                |                        | b15                             | ... | b8 b7 | ... | b0 | (s) | 00H                   |  | ASCII 10 <sup>0</sup>           |  |  | (s)+1 |                       |  |                       |  |  | (s)+2 |                       |  |                       |  |  | (s)+3 |                       |  |                       |  |  | (s)+4 |                       |  |                       |  |  | (s)+5 |  |  |  |  |  | <ul style="list-style-type: none"><li>• Positive value (2 digits in numeric part)</li><li>• Negative value (1 digit in numeric part)</li></ul> | <ul style="list-style-type: none"><li>• Set 00H in the lower byte of (s)+1.</li><li>• The data of the upper byte of (s)+1 or later is ignored.</li></ul> <table><tr><td></td><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td colspan="2">ASCII 10<sup>0</sup></td><td colspan="2">ASCII 10<sup>1</sup> / 2DH (-)</td><td></td></tr><tr><td>(s)+1</td><td colspan="5">00H</td></tr><tr><td>(s)+2</td><td colspan="5"></td></tr><tr><td>(s)+3</td><td colspan="5"></td></tr><tr><td>(s)+4</td><td colspan="5"></td></tr><tr><td>(s)+5</td><td colspan="5"></td></tr></table>                                                                                                                                                                                                                                                                                       |  | b15 | ... | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>0</sup> |  | ASCII 10 <sup>1</sup> / 2DH (-) |  |  | (s)+1 | 00H                   |  |                       |  |  | (s)+2 |                       |  |                       |  |  | (s)+3 |                       |  |                       |  |  | (s)+4 |                       |  |                       |  |  | (s)+5 |  |  |                       |  |  |
|                                                                                                                                                 | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ...                    | b8 b7                           | ... | b0    |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)                                                                                                                                             | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                        | ASCII 10 <sup>0</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+1                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+2                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+3                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+4                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+5                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
|                                                                                                                                                 | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ...                    | b8 b7                           | ... | b0    |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)                                                                                                                                             | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>1</sup> / 2DH (-) |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+1                                                                                                                                           | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+2                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+3                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+4                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+5                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| ⋮                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| <ul style="list-style-type: none"><li>• Positive value (9 digits in numeric part)</li><li>• Negative value (8 digits in numeric part)</li></ul> | <ul style="list-style-type: none"><li>• Set 00H in the upper byte of (s)+4.</li><li>• (s)+5 is ignored.</li></ul> <table><tr><td></td><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td colspan="2">ASCII 10<sup>7</sup></td><td colspan="2">ASCII 10<sup>8</sup> / 2DH (-)</td><td></td></tr><tr><td>(s)+1</td><td colspan="2">ASCII 10<sup>5</sup></td><td colspan="2">ASCII 10<sup>6</sup></td><td></td></tr><tr><td>(s)+2</td><td colspan="2">ASCII 10<sup>3</sup></td><td colspan="2">ASCII 10<sup>4</sup></td><td></td></tr><tr><td>(s)+3</td><td colspan="2">ASCII 10<sup>1</sup></td><td colspan="2">ASCII 10<sup>2</sup></td><td></td></tr><tr><td>(s)+4</td><td colspan="2">00H</td><td colspan="2">ASCII 10<sup>0</sup></td><td></td></tr><tr><td>(s)+5</td><td colspan="5"></td></tr></table> |                        | b15                             | ... | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>7</sup> |  | ASCII 10 <sup>8</sup> / 2DH (-) |  |  | (s)+1 | ASCII 10 <sup>5</sup> |  | ASCII 10 <sup>6</sup> |  |  | (s)+2 | ASCII 10 <sup>3</sup> |  | ASCII 10 <sup>4</sup> |  |  | (s)+3 | ASCII 10 <sup>1</sup> |  | ASCII 10 <sup>2</sup> |  |  | (s)+4 | 00H                   |  | ASCII 10 <sup>0</sup> |  |  | (s)+5 |  |  |  |  |  | Negative value (9 digits in numeric part)                                                                                                      | <ul style="list-style-type: none"><li>• Set 00H in the lower byte of (s)+5.</li><li>• The data of the upper byte of (s)+5 is ignored.</li></ul> <table><tr><td></td><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td colspan="2">ASCII 10<sup>8</sup></td><td colspan="2">2DH (-)</td><td></td></tr><tr><td>(s)+1</td><td colspan="2">ASCII 10<sup>6</sup></td><td colspan="2">ASCII 10<sup>7</sup></td><td></td></tr><tr><td>(s)+2</td><td colspan="2">ASCII 10<sup>4</sup></td><td colspan="2">ASCII 10<sup>5</sup></td><td></td></tr><tr><td>(s)+3</td><td colspan="2">ASCII 10<sup>2</sup></td><td colspan="2">ASCII 10<sup>3</sup></td><td></td></tr><tr><td>(s)+4</td><td colspan="2">ASCII 10<sup>0</sup></td><td colspan="2">ASCII 10<sup>1</sup></td><td></td></tr><tr><td>(s)+5</td><td colspan="2"></td><td colspan="2">00H</td><td></td></tr></table> |  | b15 | ... | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>8</sup> |  | 2DH (-)                         |  |  | (s)+1 | ASCII 10 <sup>6</sup> |  | ASCII 10 <sup>7</sup> |  |  | (s)+2 | ASCII 10 <sup>4</sup> |  | ASCII 10 <sup>5</sup> |  |  | (s)+3 | ASCII 10 <sup>2</sup> |  | ASCII 10 <sup>3</sup> |  |  | (s)+4 | ASCII 10 <sup>0</sup> |  | ASCII 10 <sup>1</sup> |  |  | (s)+5 |  |  | 00H                   |  |  |
|                                                                                                                                                 | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ...                    | b8 b7                           | ... | b0    |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)                                                                                                                                             | ASCII 10 <sup>7</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>8</sup> / 2DH (-) |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+1                                                                                                                                           | ASCII 10 <sup>5</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>6</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+2                                                                                                                                           | ASCII 10 <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>4</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+3                                                                                                                                           | ASCII 10 <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>2</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+4                                                                                                                                           | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                        | ASCII 10 <sup>0</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+5                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
|                                                                                                                                                 | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ...                    | b8 b7                           | ... | b0    |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)                                                                                                                                             | ASCII 10 <sup>8</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | 2DH (-)                         |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+1                                                                                                                                           | ASCII 10 <sup>6</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>7</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+2                                                                                                                                           | ASCII 10 <sup>4</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>5</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+3                                                                                                                                           | ASCII 10 <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>3</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+4                                                                                                                                           | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>1</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+5                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        | 00H                             |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| Positive value (10 digits in numeric part)                                                                                                      | (s)+5 is ignored. Since the number of digits is the maximum, 00H is not required to be set. <table><tr><td></td><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td colspan="2">ASCII 10<sup>8</sup></td><td colspan="2">ASCII 10<sup>9</sup></td><td></td></tr><tr><td>(s)+1</td><td colspan="2">ASCII 10<sup>6</sup></td><td colspan="2">ASCII 10<sup>7</sup></td><td></td></tr><tr><td>(s)+2</td><td colspan="2">ASCII 10<sup>4</sup></td><td colspan="2">ASCII 10<sup>5</sup></td><td></td></tr><tr><td>(s)+3</td><td colspan="2">ASCII 10<sup>2</sup></td><td colspan="2">ASCII 10<sup>3</sup></td><td></td></tr><tr><td>(s)+4</td><td colspan="2">ASCII 10<sup>0</sup></td><td colspan="2">ASCII 10<sup>1</sup></td><td></td></tr><tr><td>(s)+5</td><td colspan="5"></td></tr></table>                |                        | b15                             | ... | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>8</sup> |  | ASCII 10 <sup>9</sup>           |  |  | (s)+1 | ASCII 10 <sup>6</sup> |  | ASCII 10 <sup>7</sup> |  |  | (s)+2 | ASCII 10 <sup>4</sup> |  | ASCII 10 <sup>5</sup> |  |  | (s)+3 | ASCII 10 <sup>2</sup> |  | ASCII 10 <sup>3</sup> |  |  | (s)+4 | ASCII 10 <sup>0</sup> |  | ASCII 10 <sup>1</sup> |  |  | (s)+5 |  |  |  |  |  | Negative value (10 digits in numeric part)                                                                                                     | The data of the upper byte of (s)+5 is ignored. Since the number of digits is the maximum, 00H is not required to be set. <table><tr><td></td><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td colspan="2">ASCII 10<sup>9</sup></td><td colspan="2">2DH (-)</td><td></td></tr><tr><td>(s)+1</td><td colspan="2">ASCII 10<sup>7</sup></td><td colspan="2">ASCII 10<sup>8</sup></td><td></td></tr><tr><td>(s)+2</td><td colspan="2">ASCII 10<sup>5</sup></td><td colspan="2">ASCII 10<sup>6</sup></td><td></td></tr><tr><td>(s)+3</td><td colspan="2">ASCII 10<sup>3</sup></td><td colspan="2">ASCII 10<sup>4</sup></td><td></td></tr><tr><td>(s)+4</td><td colspan="2">ASCII 10<sup>1</sup></td><td colspan="2">ASCII 10<sup>2</sup></td><td></td></tr><tr><td>(s)+5</td><td colspan="2"></td><td colspan="2">ASCII 10<sup>0</sup></td><td></td></tr></table>      |  | b15 | ... | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>9</sup> |  | 2DH (-)                         |  |  | (s)+1 | ASCII 10 <sup>7</sup> |  | ASCII 10 <sup>8</sup> |  |  | (s)+2 | ASCII 10 <sup>5</sup> |  | ASCII 10 <sup>6</sup> |  |  | (s)+3 | ASCII 10 <sup>3</sup> |  | ASCII 10 <sup>4</sup> |  |  | (s)+4 | ASCII 10 <sup>1</sup> |  | ASCII 10 <sup>2</sup> |  |  | (s)+5 |  |  | ASCII 10 <sup>0</sup> |  |  |
|                                                                                                                                                 | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ...                    | b8 b7                           | ... | b0    |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)                                                                                                                                             | ASCII 10 <sup>8</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>9</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+1                                                                                                                                           | ASCII 10 <sup>6</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>7</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+2                                                                                                                                           | ASCII 10 <sup>4</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>5</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+3                                                                                                                                           | ASCII 10 <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>3</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+4                                                                                                                                           | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>1</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+5                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
|                                                                                                                                                 | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ...                    | b8 b7                           | ... | b0    |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)                                                                                                                                             | ASCII 10 <sup>9</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | 2DH (-)                         |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+1                                                                                                                                           | ASCII 10 <sup>7</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>8</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+2                                                                                                                                           | ASCII 10 <sup>5</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>6</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+3                                                                                                                                           | ASCII 10 <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>4</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+4                                                                                                                                           | ASCII 10 <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        | ASCII 10 <sup>2</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |
| (s)+5                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        | ASCII 10 <sup>0</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |  |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |  |  |                       |  |  |

ASCII 10<sup>0</sup>: Ones place of ASCII code  
ASCII 10<sup>1</sup>: Tens place of ASCII code  
⋮  
ASCII 10<sup>9</sup>: Billions place of ASCII code

- The ASCII data in the device specified by (s) to (s)+5 is within the range from -2147483648 to 2147483647 for the DDABIN(P) instruction, and it is within the range from 0 to 4294967295 for the DDABIN(P)\_U instruction.
- Set 2DH (-) to lower byte of (s)+0 as sign data when the ASCII data is negative. Set an ASCII code of the uppermost digit instead of setting sign data when the ASCII data is 0 or positive.
- A value from 30H to 39H can be set in each place of ASCII code.
- If the value is positive and the numeric part has 10 digits, the data stored in (s)+5 or later is ignored. If the value is negative and the numeric part has 10 digits, the data stored in the upper byte of (s)+5 or later is ignored.
- If a value 20H is set in each place of ASCII code, the value is processed as 30H. If a value 00H is set, the value is processed as the end of the decimal ASCII data.
- In the following cases, "0" is stored in (d).
  - The first character is 00H (NULL).
  - The first character is 2DH (-) and the second character is 00H (NULL).

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | Invalid data that cannot be converted are input in (s) to (s)+5. <ul style="list-style-type: none"><li>• The ASCII code of the first character is other than 2DH, 30H to 39H, 20H, and 00H.*<sup>1</sup></li><li>• The ASCII code of the second character or later is other than 30H to 39H, 20H, and 00H.</li><li>• When the DDABIN(P) instruction is used, ASCII data is out of the range from -2147483648 to 2147483647.</li><li>• When the DDABIN(P)_U instruction is used, ASCII data is out of the range from 0 to 4294967295.</li></ul> |

\*<sup>1</sup> When SM705 (Number of conversion digits selection) is off, no error is detected no matter what value is set for the ASCII code of the first character.



# Converting hexadecimal ASCII data to 16-bit binary data

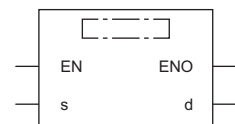
12

## HABIN(P)

These instructions convert hexadecimal ASCII data to 16-bit binary data.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | <pre>ENO:=HABIN(EN,s,d); ENO:=HABINP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| HABIN       |                     |
| HABINP      |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                                  | Range | Data type            | Data type (label) |
|---------|----------------------------------------------------------------------------------------------|-------|----------------------|-------------------|
| (s)     | ASCII data to be converted to binary data or the start device where the ASCII data is stored | —     | String               | ANYSTRING_SINGLE  |
| (d)     | Device for storing the conversion result                                                     | —     | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                                          | —     | Bit                  | BOOL              |
| ENO     | Execution result                                                                             | —     | Bit                  | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

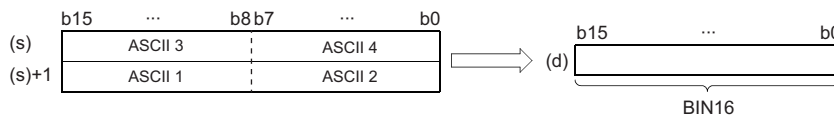
## Processing details

- These instructions convert the hexadecimal ASCII data stored in the device areas specified by (s) and later to 16-bit binary data, and store the converted data in the device specified by (d).
- The setting method of the hexadecimal ASCII data to be set in (s) depends on the status of SM705 (Number of conversion digits selection).

| Status of SM705 | Setting method of (s)                                        | Reference                                                                                    |
|-----------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Off             | Set (s) with a fixed number of digits (4 digits).            | Page 460 Setting method of (s) for when SM705 (Number of conversion digits selection) is off |
| On              | Set (s) with a desired number of digits (maximum: 4 digits). | Page 460 Setting method of (s) for when SM705 (Number of conversion digits selection) is on  |

### ■Setting method of (s) for when SM705 (Number of conversion digits selection) is off

- Set hexadecimal ASCII data with 4 digits (fixed) in (s) to (s)+1.

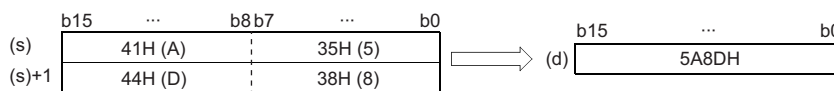


ASCII □: ASCII code (□th digit)

- The ASCII data in the device specified by (s) to (s)+1 is within the range from 0000H to FFFFH.
- The data of (s)+2 or later is ignored.
- A value from 30H to 39H and 41H to 46H can be set in each place of ASCII code.

#### Ex.

When 5A8DH is specified in (s)



### ■Setting method of (s) for when SM705 (Number of conversion digits selection) is on

Set hexadecimal ASCII data with a desired number of digits (including 00H (NULL code)) in (s). Note that 00H (NULL code) is not required to be set for the maximum number of digits (4 digits).

The following table lists the setting method of (s).

| Value to be set in (s) | Data of (s) to (s)+1                                                                                                                                                                                                                               | Value to be set in (s) | Data of (s) to (s)+1                                                                                                                                                                                                                                         |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0H to FH               | <ul style="list-style-type: none"> <li>• Set 00H in the upper byte of (s)+0.</li> <li>• The data of (s)+1 or later is ignored.</li> </ul> <div> <div>b15 ... b8 b7 ... b0</div> <div>(s) 00H ASCII 1</div> <div>(s)+1</div> </div>                 | 10H to FFH             | <ul style="list-style-type: none"> <li>• Set 00H in the lower byte of (s)+1.</li> <li>• The data of the upper byte of (s)+1 or later is ignored.</li> </ul> <div> <div>b15 ... b8 b7 ... b0</div> <div>(s) ASCII 1 ASCII 2</div> <div>(s)+1 00H</div> </div> |
| 100H to FFFH           | <ul style="list-style-type: none"> <li>• Set 00H in the upper byte of (s)+1.</li> <li>• The data of (s)+2 or later is ignored.</li> </ul> <div> <div>b15 ... b8 b7 ... b0</div> <div>(s) ASCII 2 ASCII 3</div> <div>(s)+1 00H ASCII 1</div> </div> | 1000H to FFFFH         | <p>The data of (s)+2 or later is ignored.</p> <div> <div>b15 ... b8 b7 ... b0</div> <div>(s) ASCII 3 ASCII 4</div> <div>(s)+1 ASCII 1 ASCII 2</div> </div>                                                                                                   |

ASCII □: ASCII code (□th digit)

- The ASCII data in the device specified by (s) to (s)+1 is within the range from 0000H to FFFFH.
- The data of (s)+2 or later is ignored.
- A value from 30H to 39H and 41H to 46H can be set in each place of ASCII code.
- If a value 00H is set in each place of ASCII code, the value will be processed as the end of the hexadecimal ASCII data.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                             |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | Invalid data that cannot be converted are input in (s) to (s)+1. <ul style="list-style-type: none"><li>• A value in each place of ASCII code is other than "30H" to "39H" and "41H" to "46H".</li></ul> |

12

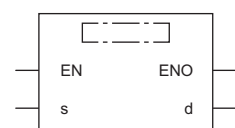
# Converting hexadecimal ASCII data to 32-bit binary data

## DHABIN(P)

These instructions convert hexadecimal ASCII data to 32-bit binary data.

| Ladder | ST                                                    |
|--------|-------------------------------------------------------|
|        | <pre>ENO:=DHABIN(EN,s,d); ENO:=DHABINP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DHABIN      |                     |
| DHABINP     |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                                  | Range | Data type            | Data type (label) |
|---------|----------------------------------------------------------------------------------------------|-------|----------------------|-------------------|
| (s)     | ASCII data to be converted to binary data or the start device where the ASCII data is stored | —     | String               | ANYSTRING_SINGLE  |
| (d)     | Start device for storing the conversion result                                               | —     | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                                                          | —     | Bit                  | BOOL              |
| ENO     | Execution result                                                                             | —     | Bit                  | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

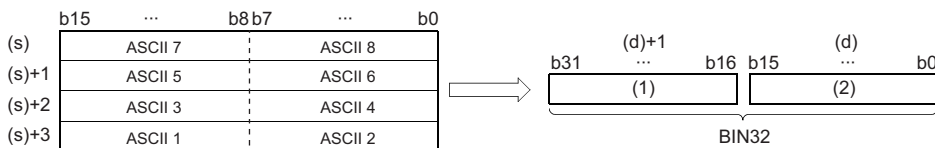
## Processing details

- These instructions convert the hexadecimal ASCII data stored in the device specified by (s) and later to 32-bit binary data, and store the converted data in the device specified by (d).
- The setting method of the hexadecimal ASCII data to be set in (s) depends on the status of SM705 (Number of conversion digits selection).

| Status of SM705 | Setting method of (s)                                        | Reference                                                                                    |
|-----------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Off             | Set (s) with a fixed number of digits (8 digits).            | Page 463 Setting method of (s) for when SM705 (Number of conversion digits selection) is off |
| On              | Set (s) with a desired number of digits (maximum: 8 digits). | Page 464 Setting method of (s) for when SM705 (Number of conversion digits selection) is on  |

### ■ Setting method of (s) for when SM705 (Number of conversion digits selection) is off

- Set hexadecimal ASCII data with 8 digits (fixed) in (s) to (s)+3.



ASCII □: ASCII code (□th digit)

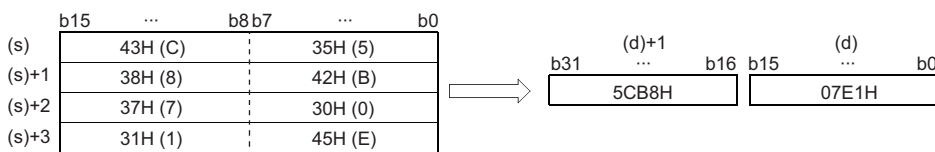
(1) Upper 16 bits

(2) Lower 16 bits

- The ASCII data in the device specified by (s) to (s)+3 is within the range from 00000000H to FFFFFFFFH.
- The data of (s)+4 or later is ignored.
- A value from 30H to 39H and 41H to 46H can be set in each place of ASCII code.

#### Ex.

When 5CB807E1H is specified in (s)



## ■Setting method of (s) for when SM705 (Number of conversion digits selection) is on

Set hexadecimal ASCII data with a desired number of digits (including 00H (NULL code)) in (s). Note that 00H (NULL code) is not required to be set for the maximum number of digits (8 digits).

The following table lists the setting method of (s).

| Value to be set in (s) | Data of (s) to (s)+3                                                                                                                                                                                                                                                                                                                                                                                                                  | Value to be set in (s) | Data of (s) to (s)+3 |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------|---------|-------|---------|---------|-------|---------|---------|-------|-----|---------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------|---------|-------|---------|---------|-------|---------|---------|-------|---------|---------|
| 0H to FH               | <ul style="list-style-type: none"><li>Set 00H in the upper byte of (s).</li><li>The data of (s)+1 or later is ignored.</li></ul> <div><div>b15      ...      b8b7      ...      b0</div><table><tr><td>(s)</td><td>00H</td><td>ASCII 1</td></tr><tr><td>(s)+1</td><td></td><td></td></tr><tr><td>(s)+2</td><td></td><td></td></tr><tr><td>(s)+3</td><td></td><td></td></tr></table></div>                                             | (s)                    | 00H                  | ASCII 1 | (s)+1 |         |         | (s)+2 |         |         | (s)+3 |     |         | 10H to FFH             | <ul style="list-style-type: none"><li>Set 00H in the lower byte of (s)+1.</li><li>The data of the upper byte of (s)+1 or later is ignored.</li></ul> <div><div>b15      ...      b8b7      ...      b0</div><table><tr><td>(s)</td><td>ASCII 1</td><td>ASCII 2</td></tr><tr><td>(s)+1</td><td></td><td>00H</td></tr><tr><td>(s)+2</td><td></td><td></td></tr><tr><td>(s)+3</td><td></td><td></td></tr></table></div> | (s) | ASCII 1 | ASCII 2 | (s)+1 |         | 00H     | (s)+2 |         |         | (s)+3 |         |         |
| (s)                    | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                   | ASCII 1                |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+1                  |                                                                                                                                                                                                                                                                                                                                                                                                                                       |                        |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+2                  |                                                                                                                                                                                                                                                                                                                                                                                                                                       |                        |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+3                  |                                                                                                                                                                                                                                                                                                                                                                                                                                       |                        |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)                    | ASCII 1                                                                                                                                                                                                                                                                                                                                                                                                                               | ASCII 2                |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+1                  |                                                                                                                                                                                                                                                                                                                                                                                                                                       | 00H                    |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+2                  |                                                                                                                                                                                                                                                                                                                                                                                                                                       |                        |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+3                  |                                                                                                                                                                                                                                                                                                                                                                                                                                       |                        |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| ⋮                      |                                                                                                                                                                                                                                                                                                                                                                                                                                       |                        |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| 1000000H to FFFFFFFFH  | <ul style="list-style-type: none"><li>Set 00H in the upper byte of (s)+3.</li><li>The data of (s)+4 or later is ignored.</li></ul> <div><div>b15      ...      b8b7      ...      b0</div><table><tr><td>(s)</td><td>ASCII 6</td><td>ASCII 7</td></tr><tr><td>(s)+1</td><td>ASCII 4</td><td>ASCII 5</td></tr><tr><td>(s)+2</td><td>ASCII 2</td><td>ASCII 3</td></tr><tr><td>(s)+3</td><td>00H</td><td>ASCII 1</td></tr></table></div> | (s)                    | ASCII 6              | ASCII 7 | (s)+1 | ASCII 4 | ASCII 5 | (s)+2 | ASCII 2 | ASCII 3 | (s)+3 | 00H | ASCII 1 | 10000000H to FFFFFFFFH | The data of (s)+4 or later is ignored. <div><div>b15      ...      b8b7      ...      b0</div><table><tr><td>(s)</td><td>ASCII 7</td><td>ASCII 8</td></tr><tr><td>(s)+1</td><td>ASCII 5</td><td>ASCII 6</td></tr><tr><td>(s)+2</td><td>ASCII 3</td><td>ASCII 4</td></tr><tr><td>(s)+3</td><td>ASCII 1</td><td>ASCII 2</td></tr></table></div>                                                                        | (s) | ASCII 7 | ASCII 8 | (s)+1 | ASCII 5 | ASCII 6 | (s)+2 | ASCII 3 | ASCII 4 | (s)+3 | ASCII 1 | ASCII 2 |
| (s)                    | ASCII 6                                                                                                                                                                                                                                                                                                                                                                                                                               | ASCII 7                |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+1                  | ASCII 4                                                                                                                                                                                                                                                                                                                                                                                                                               | ASCII 5                |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+2                  | ASCII 2                                                                                                                                                                                                                                                                                                                                                                                                                               | ASCII 3                |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+3                  | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                   | ASCII 1                |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)                    | ASCII 7                                                                                                                                                                                                                                                                                                                                                                                                                               | ASCII 8                |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+1                  | ASCII 5                                                                                                                                                                                                                                                                                                                                                                                                                               | ASCII 6                |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+2                  | ASCII 3                                                                                                                                                                                                                                                                                                                                                                                                                               | ASCII 4                |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |
| (s)+3                  | ASCII 1                                                                                                                                                                                                                                                                                                                                                                                                                               | ASCII 2                |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |

ASCII □: ASCII code (□th digit)

- The ASCII data in the device specified by (s) to (s)+3 is within the range from 00000000H to FFFFFFFFH.
- The data of (s)+4 or later is ignored.
- A value from 30H to 39H and 41H to 46H can be set in each place of ASCII code.
- If a value 00H is set in each place of ASCII code, the value will be processed as the end of the hexadecimal ASCII data.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                    |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | <p>Invalid data that cannot be converted are input in (s) to (s)+3.</p> <ul style="list-style-type: none"> <li>A value in each place of ASCII code is other than "30H" to "39H" and "41H" to "46H".</li> </ul> |

# Converting decimal ASCII data to BCD 4-digit data

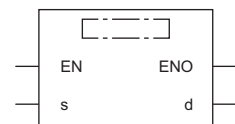
12

## DABCD(P)

These instructions convert decimal ASCII data to BCD 4-digit data.

| Ladder | ST                                         |
|--------|--------------------------------------------|
|        | ENO:=DABCD(EN,s,d);<br>ENO:=DABCDP(EN,s,d) |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DABCD       |                     |
| DABCDP      |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                               | Range | Data type   | Data type (label) |
|---------|-------------------------------------------------------------------------------------------|-------|-------------|-------------------|
| (s)     | ASCII data to be converted to BCD data or the start device where the ASCII data is stored | —     | String      | ANYSTRING_SINGLE  |
| (d)     | Device for storing the conversion result                                                  | —     | BCD 4-digit | ANY16             |
| EN      | Execution condition                                                                       | —     | Bit         | BOOL              |
| ENO     | Execution result                                                                          | —     | Bit         | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |

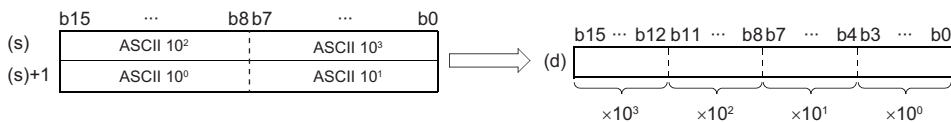
## Processing details

- These instructions convert the decimal ASCII data stored in the device areas specified by (s) and later to BCD 4-digit data, and store the converted data in the device specified by (d).
- The setting method of the decimal ASCII data to be set in (s) depends on the status of SM705 (Number of conversion digits selection).

| Status of SM705 | Setting method of (s)                                        | Reference                                                                                    |
|-----------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Off             | Set (s) with a fixed number of digits (4 digits).            | Page 466 Setting method of (s) for when SM705 (Number of conversion digits selection) is off |
| On              | Set (s) with a desired number of digits (maximum: 4 digits). | Page 467 Setting method of (s) for when SM705 (Number of conversion digits selection) is on  |

### ■ Setting method of (s) for when SM705 (Number of conversion digits selection) is off

- Set decimal ASCII data the 4 digits (fixed) in (s) to (s)+1.



ASCII 10<sup>3</sup>: Thousands place of ASCII code

ASCII 10<sup>2</sup>: Hundreds place of ASCII code

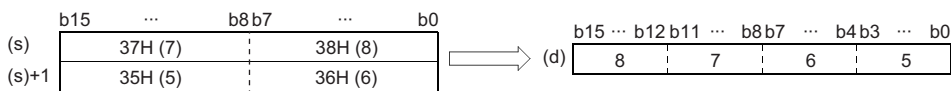
ASCII 10<sup>1</sup>: Tens place of ASCII code

ASCII 10<sup>0</sup>: Ones place of ASCII code

- The ASCII data in the device specified by (s) to (s)+1 is within the range from 0 to 9999.
- The data of (s)+2 or later is ignored.
- A value from 30H to 39H can be set in each place of ASCII code.
- If a value 20H or 00H is set in each place of ASCII code, the value will be processed as 30H.

#### Ex.

When 8765 is specified in (s)





### ■Setting method of (s) for when SM705 (Number of conversion digits selection) is on

Set decimal ASCII data with a desired number of digits (including 00H (NULL code)) in (s). Note that 00H (NULL code) is not required to be set for the maximum number of digits (4 digits).

The following table lists the setting method of (s).

| Value to be set in (s) | Data of (s) to (s)+1                                                                                                                                                                                                                                                                                          | Value to be set in (s) | Data of (s) to (s)+1                                                                                                                                                                                                                                                                                    |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 9                 | <ul style="list-style-type: none"> <li>Set 00H in the upper byte of (s)+0.</li> <li>The data of (s)+1 or later is ignored.</li> </ul> <div> <div>b15    ...    b8 b7    ...    b0</div> <div>(s)    00H    ASCII 10<sup>0</sup></div> <div>(s)+1    </div> </div>                                             | 10 to 99               | <ul style="list-style-type: none"> <li>Set 00H in the lower byte of (s)+1.</li> <li>The data of the upper byte of (s)+1 or later is ignored.</li> </ul> <div> <div>b15    ...    b8 b7    ...    b0</div> <div>(s)    ASCII 10<sup>0</sup>    ASCII 10<sup>1</sup></div> <div>(s)+1    00H</div> </div> |
| 100 to 999             | <ul style="list-style-type: none"> <li>Set 00H in the upper byte of (s)+1.</li> <li>The data of (s)+2 or later is ignored.</li> </ul> <div> <div>b15    ...    b8 b7    ...    b0</div> <div>(s)    ASCII 10<sup>1</sup>    ASCII 10<sup>2</sup></div> <div>(s)+1    00H    ASCII 10<sup>0</sup></div> </div> | 1000 to 9999           | <p>The data of (s)+2 or later is ignored.</p> <div> <div>b15    ...    b8 b7    ...    b0</div> <div>(s)    ASCII 10<sup>2</sup>    ASCII 10<sup>3</sup></div> <div>(s)+1    ASCII 10<sup>0</sup>    ASCII 10<sup>1</sup></div> </div>                                                                  |

ASCII 10<sup>3</sup>: Thousands place of ASCII code

ASCII 10<sup>2</sup>: Hundreds place of ASCII code

ASCII 10<sup>1</sup>: Tens place of ASCII code

ASCII 10<sup>0</sup>: Ones place of ASCII code

- The ASCII data in the device specified by (s) to (s)+1 is within the range from 0 to 9999.
- The data of (s)+2 or later is ignored.
- A value from 30H to 39H can be set in each place of ASCII code.
- If a value 20H is set in each place of ASCII code, the value is processed as 30H. If a value 00H is set, the value is processed as the end of the decimal ASCII data.

### Operation error

| Error code (SD0) | Description                                                                                                                                                        |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | <p>Invalid data that cannot be converted are input in (s).</p> <ul style="list-style-type: none"> <li>A character other than 0 to 9 exists in the data.</li> </ul> |

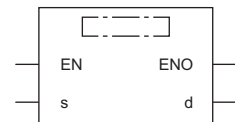
# Converting decimal ASCII data to BCD 8-digit data

## DDABCD(P)

These instructions convert decimal ASCII data to BCD 8-digit data.

| Ladder | ST                                            |
|--------|-----------------------------------------------|
|        | ENO:=DDABCD(EN,s,d);<br>ENO:=DDABCDP(EN,s,d); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DDABCD      |                     |
| DDABCDP     |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                               | Range | Data type   | Data type (label) |
|---------|-------------------------------------------------------------------------------------------|-------|-------------|-------------------|
| (s)     | ASCII data to be converted to BCD data or the start device where the ASCII data is stored | —     | String      | ANYSTRING_SINGLE  |
| (d)     | Start device for storing the conversion result                                            | —     | BCD 8-digit | ANY32             |
| EN      | Execution condition                                                                       | —     | Bit         | BOOL              |
| ENO     | Execution result                                                                          | —     | Bit         | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

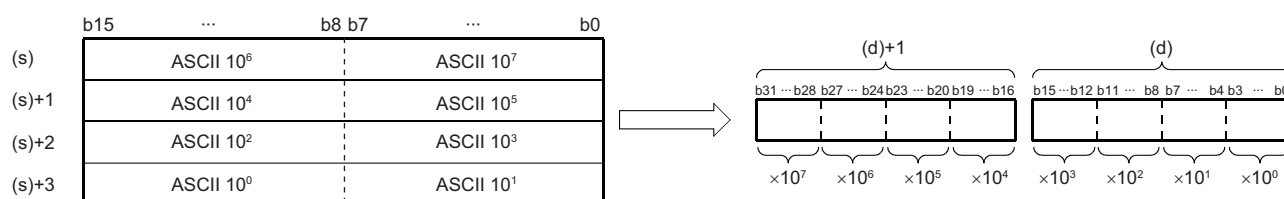
## Processing details

- These instructions convert the decimal ASCII data stored in the device areas specified by (s) and later to BCD 8-digit data, and store the converted data in the device number specified by (d).
- The setting method of the decimal ASCII data to be set in (s) depends on the status of SM705 (Number of conversion digits selection).

| Status of SM705 | Setting method of (s)                                        | Reference                                                                                    |
|-----------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Off             | Set (s) with a fixed number of digits (8 digits).            | Page 469 Setting method of (s) for when SM705 (Number of conversion digits selection) is off |
| On              | Set (s) with a desired number of digits (maximum: 8 digits). | Page 470 Setting method of (s) for when SM705 (Number of conversion digits selection) is on  |

### ■ Setting method of (s) for when SM705 (Number of conversion digits selection) is off

- Set decimal ASCII data with 8 digits (fixed) in (s) to (s)+3.



ASCII 10<sup>7</sup>: Ten-millions place of ASCII code

ASCII 10<sup>6</sup>: Millions place of ASCII code

ASCII 10<sup>5</sup>: Hundred-thousands place of ASCII code

ASCII 10<sup>4</sup>: Ten-thousands place of ASCII code

ASCII 10<sup>3</sup>: Thousands place of ASCII code

ASCII 10<sup>2</sup>: Hundreds place of ASCII code

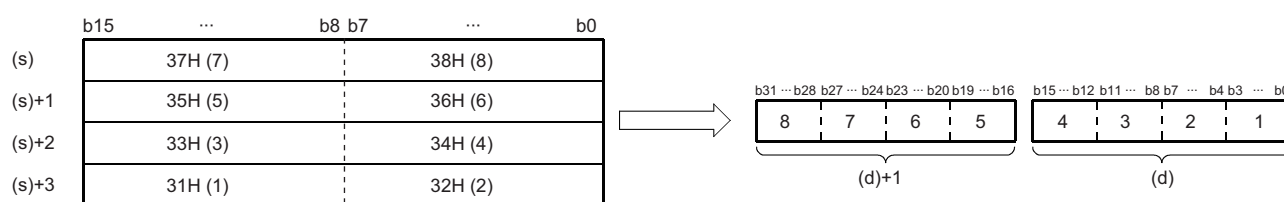
ASCII 10<sup>1</sup>: Tens place of ASCII code

ASCII 10<sup>0</sup>: Ones place of ASCII code

- The ASCII data in the device specified by (s) to (s)+3 is within the range from 0 to 99999999.
- The data of (s)+4 or later is ignored.
- A value from 30H to 39H can be set in each place of ASCII code.
- If a value 20H or 00H is set in each place of ASCII code, the value will be processed as 30H.

#### Ex.

When 87654321 is specified in (s)



## ■Setting method of (s) for when SM705 (Number of conversion digits selection) is on

Set decimal ASCII data with a desired number of digits (including 00H (NULL code)) in (s). Note that 00H (NULL code) is not required to be set for the maximum number of digits (8 digits).

The following table lists the setting method of (s).

| Value to be set in (s) | Data of (s) to (s)+3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Value to be set in (s) | Data of (s) to (s)+3  |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------------|-------|-----|----|-----|-----------------------|--|-----------------------|--|-------|-----------------------|--|-----------------------|--|-------|-----------------------|--|-----------------------|--|-------|-----|--|-----------------------|--|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-----|----|-----|-----------------------|--|-----------------------|--|-------|-----------------------|--|-----------------------|--|-------|-----------------------|--|-----------------------|--|-------|-----------------------|--|-----------------------|--|
| 0 to 9                 | <ul style="list-style-type: none"><li>Set 00H in the upper byte of (s).</li><li>The data of (s)+1 or later is ignored.</li></ul> <div><table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td>00H</td><td></td><td>ASCII 10<sup>0</sup></td><td></td></tr><tr><td>(s)+1</td><td colspan="4"></td></tr><tr><td>(s)+2</td><td colspan="4"></td></tr><tr><td>(s)+3</td><td colspan="4"></td></tr></table></div>                                                                                                                                                                        | b15                    | ...                   | b8 b7 | ... | b0 | (s) | 00H                   |  | ASCII 10 <sup>0</sup> |  | (s)+1 |                       |  |                       |  | (s)+2 |                       |  |                       |  | (s)+3 |     |  |                       |  | 10 to 99             | <ul style="list-style-type: none"><li>Set 00H in the lower byte of (s)+1.</li><li>The data of the upper byte of (s)+1 or later is ignored.</li></ul> <div><table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td>ASCII 10<sup>0</sup></td><td></td><td>ASCII 10<sup>1</sup></td><td></td></tr><tr><td>(s)+1</td><td></td><td></td><td>00H</td><td></td></tr><tr><td>(s)+2</td><td colspan="4"></td></tr><tr><td>(s)+3</td><td colspan="4"></td></tr></table></div>                                      | b15 | ... | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>0</sup> |  | ASCII 10 <sup>1</sup> |  | (s)+1 |                       |  | 00H                   |  | (s)+2 |                       |  |                       |  | (s)+3 |                       |  |                       |  |
| b15                    | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | b8 b7                  | ...                   | b0    |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)                    | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        | ASCII 10 <sup>0</sup> |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+1                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        |                       |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+2                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        |                       |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+3                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        |                       |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| b15                    | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | b8 b7                  | ...                   | b0    |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)                    | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        | ASCII 10 <sup>1</sup> |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+1                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        | 00H                   |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+2                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        |                       |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+3                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        |                       |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| ⋮                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        |                       |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| 1000000 to 9999999     | <ul style="list-style-type: none"><li>Set 00H in the upper byte of (s)+3.</li><li>The data of (s)+4 or later is ignored.</li></ul> <div><table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td>ASCII 10<sup>5</sup></td><td></td><td>ASCII 10<sup>6</sup></td><td></td></tr><tr><td>(s)+1</td><td>ASCII 10<sup>3</sup></td><td></td><td>ASCII 10<sup>4</sup></td><td></td></tr><tr><td>(s)+2</td><td>ASCII 10<sup>1</sup></td><td></td><td>ASCII 10<sup>2</sup></td><td></td></tr><tr><td>(s)+3</td><td>00H</td><td></td><td>ASCII 10<sup>0</sup></td><td></td></tr></table></div> | b15                    | ...                   | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>5</sup> |  | ASCII 10 <sup>6</sup> |  | (s)+1 | ASCII 10 <sup>3</sup> |  | ASCII 10 <sup>4</sup> |  | (s)+2 | ASCII 10 <sup>1</sup> |  | ASCII 10 <sup>2</sup> |  | (s)+3 | 00H |  | ASCII 10 <sup>0</sup> |  | 10000000 to 99999999 | The data of (s)+4 or later is ignored. <div><table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(s)</td><td>ASCII 10<sup>6</sup></td><td></td><td>ASCII 10<sup>7</sup></td><td></td></tr><tr><td>(s)+1</td><td>ASCII 10<sup>4</sup></td><td></td><td>ASCII 10<sup>5</sup></td><td></td></tr><tr><td>(s)+2</td><td>ASCII 10<sup>2</sup></td><td></td><td>ASCII 10<sup>3</sup></td><td></td></tr><tr><td>(s)+3</td><td>ASCII 10<sup>0</sup></td><td></td><td>ASCII 10<sup>1</sup></td><td></td></tr></table></div> | b15 | ... | b8 b7 | ... | b0 | (s) | ASCII 10 <sup>6</sup> |  | ASCII 10 <sup>7</sup> |  | (s)+1 | ASCII 10 <sup>4</sup> |  | ASCII 10 <sup>5</sup> |  | (s)+2 | ASCII 10 <sup>2</sup> |  | ASCII 10 <sup>3</sup> |  | (s)+3 | ASCII 10 <sup>0</sup> |  | ASCII 10 <sup>1</sup> |  |
| b15                    | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | b8 b7                  | ...                   | b0    |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)                    | ASCII 10 <sup>5</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        | ASCII 10 <sup>6</sup> |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+1                  | ASCII 10 <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        | ASCII 10 <sup>4</sup> |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+2                  | ASCII 10 <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        | ASCII 10 <sup>2</sup> |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+3                  | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        | ASCII 10 <sup>0</sup> |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| b15                    | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | b8 b7                  | ...                   | b0    |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)                    | ASCII 10 <sup>6</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        | ASCII 10 <sup>7</sup> |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+1                  | ASCII 10 <sup>4</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        | ASCII 10 <sup>5</sup> |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+2                  | ASCII 10 <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        | ASCII 10 <sup>3</sup> |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |
| (s)+3                  | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        | ASCII 10 <sup>1</sup> |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |     |  |                       |  |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |       |     |    |     |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |       |                       |  |                       |  |

ASCII 10<sup>7</sup>: Ten-millions place of ASCII code

ASCII 10<sup>6</sup>: Millions place of ASCII code

ASCII 10<sup>5</sup>: Hundred-thousands place of ASCII code

ASCII 10<sup>4</sup>: Ten-thousands place of ASCII code

ASCII 10<sup>3</sup>: Thousands place of ASCII code

ASCII 10<sup>2</sup>: Hundreds place of ASCII code

ASCII 10<sup>1</sup>: Tens place of ASCII code

ASCII 10<sup>0</sup>: Ones place of ASCII code

- The ASCII data in the device specified by (s) to (s)+3 is within the range from 0 to 99999999.
- The data of (s)+4 or later is ignored.
- A value from 30H to 39H can be set in each place of ASCII code.
- If a value 20H is set in each place of ASCII code, the value is processed as 30H. If a value 00H is set, the value is processed as the end of the decimal ASCII data.

## Operation error

| Error code (SD0) | Description                                                                                                                                                        |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | <p>Invalid data that cannot be converted are input in (s).</p> <ul style="list-style-type: none"> <li>A character other than 0 to 9 exists in the data.</li> </ul> |

# Converting decimal string data to 16-bit binary data

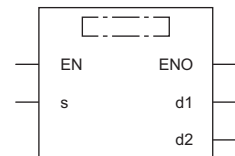
12

## VAL(P)(\_U)

These instructions convert strings to 16-bit binary data.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | ENO:=VAL(EN,s,d1,d2);<br>ENO:=VALP(EN,s,d1,d2); |

## FBD/LD



### Execution condition

| Instruction    | Execution condition |
|----------------|---------------------|
| VAL<br>VAL_U   |                     |
| VALP<br>VALP_U |                     |

### Setting data

### Description, range, data type

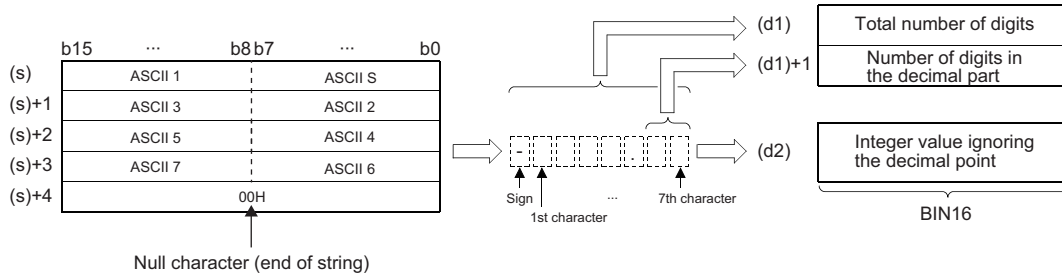
| Operand | Description                                                                                    | Range | Data type              | Data type (label)                        |
|---------|------------------------------------------------------------------------------------------------|-------|------------------------|------------------------------------------|
| (s)     | String data to be converted to binary data or the start device where the string data is stored | —     | String                 | ANYSTRING_SINGLE                         |
| (d1)    | Start device for storing the number of binary digits after conversion                          | —     | 16-bit signed binary   | ANY16_S_ARRAY<br>(Number of elements: 2) |
|         |                                                                                                |       | 16-bit unsigned binary | ANY16_U_ARRAY<br>(Number of elements: 2) |
| (d2)    | Device for storing the binary data after conversion                                            | —     | 16-bit signed binary   | ANY16_S                                  |
|         |                                                                                                |       | 16-bit unsigned binary | ANY16_U                                  |
| EN      | Execution condition                                                                            | —     | Bit                    | BOOL                                     |
| ENO     | Execution result                                                                               | —     | Bit                    | BOOL                                     |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   |             | Double word |      | Indirect specification | Constant |    |   | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|-------------|------|------------------------|----------|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —           | ○    | —                      | —        | ○  | — |        |
| (d1)    | ○                                | —    | ○                                     | —           | — | —           | —           | ○    | —                      | —        | —  | — |        |
| (d2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —           | ○    | —                      | —        | —  | — |        |

## Processing details

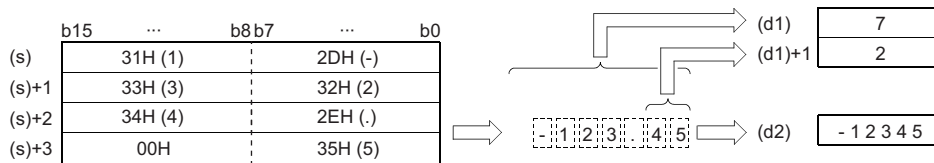
- These instructions convert the strings stored in the device numbers specified by (s) and later to 16-bit binary data, and store the number of digits in (d1) and converted binary data in the device specified by (d2). For conversion of strings to binary data, the data from the device number specified by (s) to the device number containing "00H" is processed as strings.



ASCII S: ASCII code (sign data)  
 ASCII □: ASCII code (□th character)

### Ex.

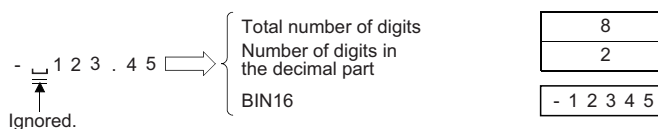
When a string "-123.45" (signed) is stored in the device specified by (s) or later



- The total number of characters of the string stored in the device specified by (s) is 2 to 8.
- Of the string stored in the device specified by (s), the number of characters in the decimal part is 0 to 5. Note, however, that the number must not exceed the total number of digits minus 3.
- A numerical string that can be converted to binary data ranges from -32768 to 32767 when a signed value is specified ignoring the decimal point or from 0 to 65535 when an unsigned value is specified. Numerical strings excluding signs and decimal points can be specified only within the range from 30H to 39H. (A value ignoring the decimal point... "-12345.6" for example becomes "-123456".)
- For the sign, "20H" can be set to indicate a positive numerical value, or "2DH" can be set to indicate a negative numerical value.
- "2EH" is set for the decimal point.
- The total number of digits stored in the device specified by (d1) includes all characters (including signs and decimal points) that represent a numerical value. The number of digits in the decimal part to be stored in the device specified by (d1)+1 represents the decimal part after 2EH(.) For the 16-bit binary data to be stored in the device specified by (d2), the string is converted to binary data by ignoring the decimal point and stored.
- If "20H" (space) or "30H" (0) exists between the sign and the first numerical value other than 0 in the string in the device specified by (s), the instruction performs conversion to binary data by ignoring "20H" and "30H".

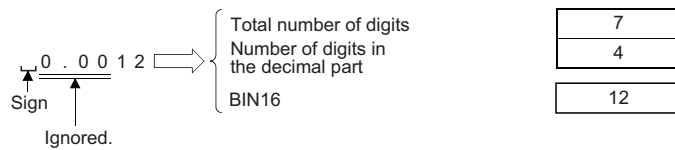
### Ex.

When "20H" exists between the sign and the first numerical value other than 0 (when a signed value is specified)



**Ex.**

When "30H" exists between the sign and the first numerical value other than 0



## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | 00H is not set between the device number specified by (s) and the last device number of the relevant device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 3281H            | <p>Invalid data that cannot be converted are input in (s).</p> <ul style="list-style-type: none"> <li>The number of characters is not between 2 and 8.</li> <li>The number of characters in the decimal part is not between 0 and 5.</li> <li>The relationship between the total number of characters and the number of characters in the decimal part is not in the following range.<br/>Total number of characters - 3 ≥ number of characters in the decimal part</li> <li>When the VAL(P) instruction is used, an ASCII code other than "20H" and "2DH" is set as a sign.</li> <li>When the VAL(P)_U instruction is used, an ASCII code other than "20H" is set as a sign.</li> <li>An ASCII code other than "30H" to "39H" and "2EH" (decimal point) is set as a digit of individual numbers.</li> <li>More than one decimal point are set.</li> </ul> <p>The converted binary value exceeds the range in which each instruction can implement conversion.</p> |
| 3285H            | The number of characters of the string in the device specified by (s) exceeds 16383.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

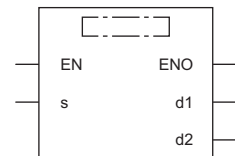
# Converting decimal string data to 32-bit binary data

## DVAL(P)(\_U)

These instructions convert strings to 32-bit binary data.

| Ladder | ST                                                |                                                       |
|--------|---------------------------------------------------|-------------------------------------------------------|
|        | ENO:=DVAL(EN,s,d1,d2);<br>ENO:=DVALP(EN,s,d1,d2); | ENO:=DVAL_U(EN,s,d1,d2);<br>ENO:=DVALP_U(EN,s,d1,d2); |

## FBD/LD



## Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| DVAL<br>DVAL_U   |                     |
| DVALP<br>DVALP_U |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                                    | Range | Data type              | Data type (label)                        |
|---------|------------------------------------------------------------------------------------------------|-------|------------------------|------------------------------------------|
| (s)     | String data to be converted to binary data or the start device where the string data is stored | —     | String                 | ANYSTRING_SINGLE                         |
| (d1)    | Start device for storing the number of binary digits after conversion                          | —     | 16-bit signed binary   | ANY16_S_ARRAY<br>(Number of elements: 2) |
|         |                                                                                                |       | 16-bit unsigned binary | ANY16_U_ARRAY<br>(Number of elements: 2) |
| (d2)    | Start device for storing the converted binary data                                             | —     | 32-bit signed binary   | ANY32_S                                  |
|         |                                                                                                |       | 32-bit unsigned binary | ANY32_U                                  |
| EN      | Execution condition                                                                            | —     | Bit                    | BOOL                                     |
| ENO     | Execution result                                                                               | —     | Bit                    | BOOL                                     |

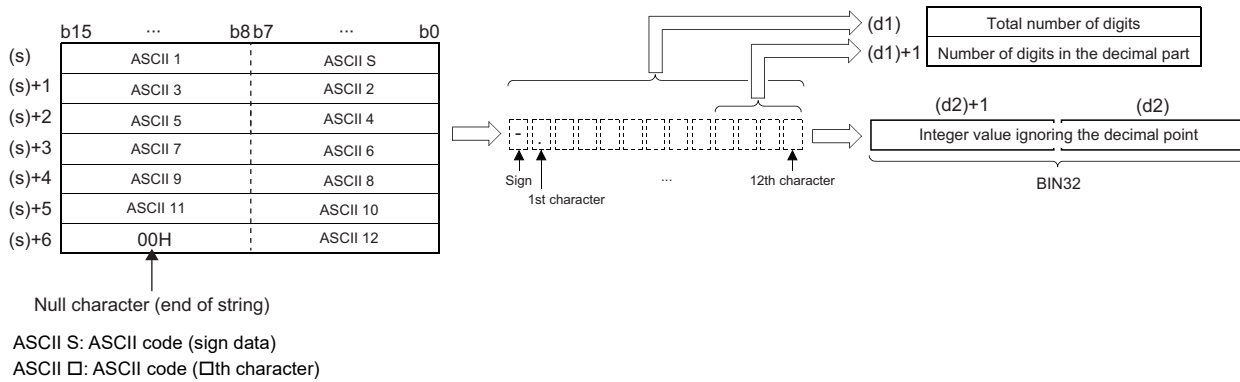
## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d1)    | ○                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d2)    | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |



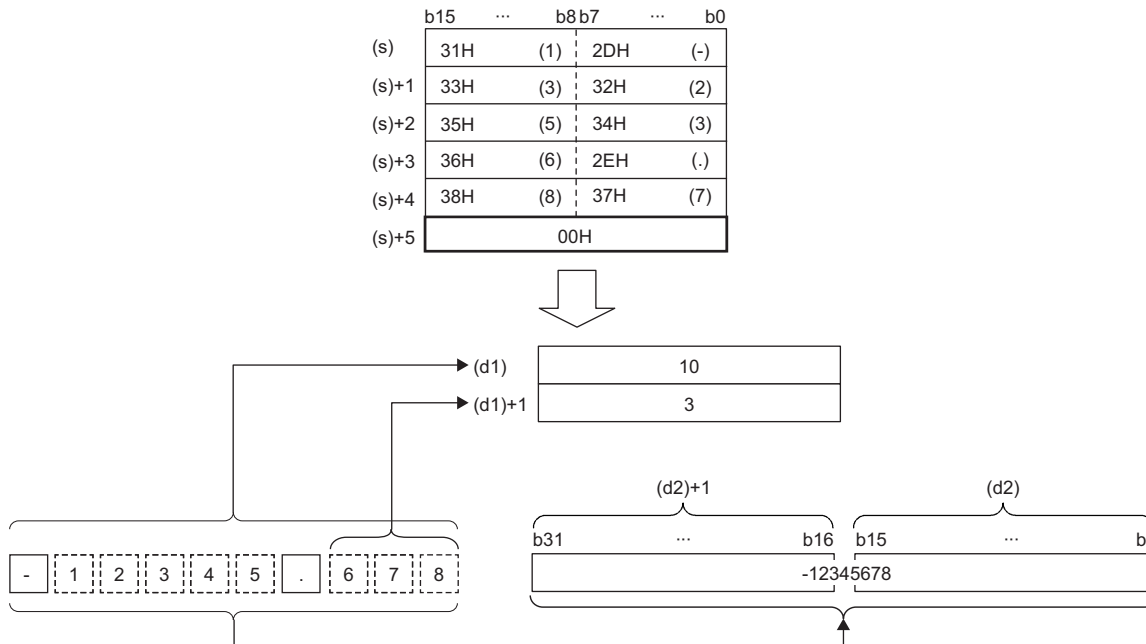
## Processing details

- These instructions convert the strings stored in the device numbers specified by (s) and later to 32-bit binary data, and store the number of digits in (d1) and converted binary data in the device specified by (d2). For conversion of strings to binary data, the data from the device number specified by (s) to the device number containing "00H" is processed as strings.



### Ex.

When a string "-12345.678" (signed) is stored in the device specified by (s) or later

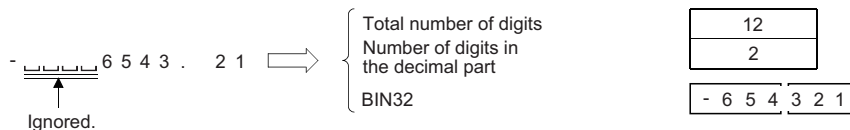


- The total number of characters of the string stored in the device specified by (s) is 2 to 13.
- Of the string stored in the device specified by (s), the number of characters in the decimal part is 0 to 10. Note, however, that the number must not exceed the total number of digits minus 3.
- The range of numerical strings that can be converted to binary is as follows. Numerical strings excluding signs and decimal points can be specified only within the range from 30H to 39H. (A value ignoring the decimal point..."-12345.6" for example becomes "-123456".)
- When a signed value ignoring the decimal point is specified: -2147483648 to 2147483647
- When an unsigned value ignoring the decimal point is specified: 0 to 4294967295
- For the sign, "20H" can be set to indicate a positive numerical value, or "2DH" can be set to indicate a negative numerical value.
- "2EH" is set for the decimal point.
- The total number of digits stored in the device specified by (d1) includes all characters (including signs and decimal points) that represent a numerical value. The number of digits in the decimal part to be stored in the device specified by (d1)+1 represents the decimal part after 2EH(.). For the 32-bit binary data to be stored in the device specified by (d2), the string is converted to binary data by ignoring the decimal point and stored.

- If "20H" (space) or "30H" (0) exists between the sign and the first numerical value other than 0 in the string in the device specified by (s), the instruction performs conversion to binary data by ignoring "20H" and "30H".

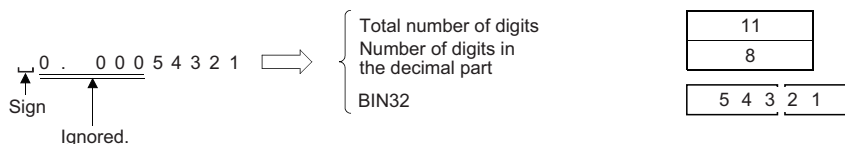
**Ex.**

When "20H" exists between the sign and the first numerical value other than 0 (when a signed value is specified)



**Ex.**

When "30H" exists between the sign and the first numerical value other than 0



## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | 00H is not set between the device number specified by (s) and the last device number of the relevant device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 3281H            | <p>Invalid data that cannot be converted are input in (s).</p> <ul style="list-style-type: none"> <li>• The number of characters of the string is not between 2 and 13.</li> <li>• The number of characters in the decimal part of the string is not between 0 and 10.</li> <li>• The relationship between the total number of characters and the number of characters in the decimal part is not in the following range.<br/>Total number of characters - 3 ≥ number of characters in the decimal part</li> <li>• When the DVAL(P) instruction is used, an ASCII code other than "20H" and "2DH" is set as a sign.</li> <li>• When the DVAL(P)_U instruction is used, an ASCII code other than "20H" is set as a sign.</li> <li>• An ASCII code other than "30H" to "39H" and "2EH" (decimal point) is set as a digit of individual numbers.</li> <li>• More than one decimal point are set.</li> </ul> <p>The converted binary value exceeds the range in which each instruction can implement conversion.</p> |
| 3285H            | The number of characters of the string in the device specified by (s) exceeds 16383.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

# Converting hexadecimal ASCII to hexadecimal binary data

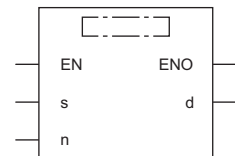
12

## ASC2INT(P)

These instructions convert hexadecimal ASCII data to binary data.

| Ladder | ST                                                          |
|--------|-------------------------------------------------------------|
|        | <pre>ENO:=ASC2INT(EN,s,n,d); ENO:=ASC2INTP(EN,s,n,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ASC2INT     |                     |
| ASC2INTP    |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                       | Range      | Data type            | Data type (label)              |
|---------|-------------------------------------------------------------------|------------|----------------------|--------------------------------|
| (s)     | Start device where the string data to be converted to binary data | —          | String               | ANYSTRING_SINGLE <sup>*1</sup> |
| (d)     | Start device for storing the converted binary data                | —          | 16-bit signed binary | ANY16 <sup>*1</sup>            |
| (n)     | Number of characters to be stored                                 | 0 to 16383 | 16-bit signed binary | ANY16                          |
| EN      | Execution condition                                               | —          | Bit                  | BOOL                           |
| ENO     | Execution result                                                  | —          | Bit                  | BOOL                           |

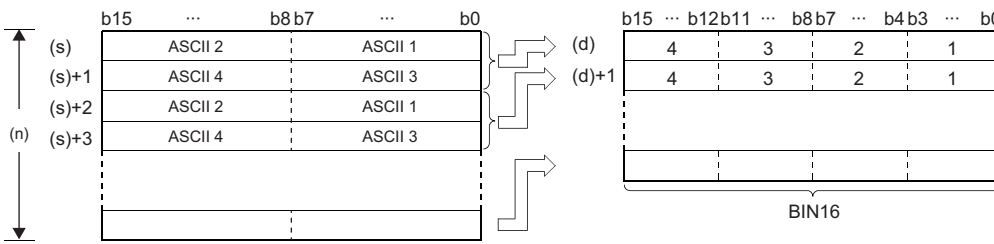
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions convert the hexadecimal ASCII data stored in the device by the number of characters specified by (n) after the device number specified by (s) and later to binary data, and store the converted data in the device number specified by (d) and later.

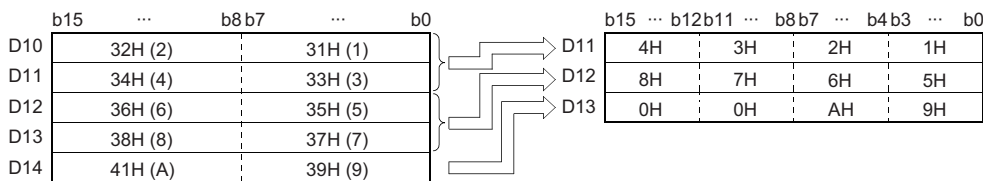


ASCII □: ASCII code (□th digit)

1 to 4: 1st to 4th digit

(n): Number of characters specified by (n)

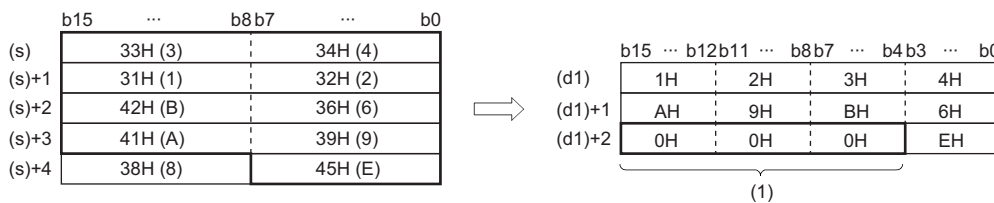
- Setting the number of characters for (n) automatically determines the range of the string in the device specified by (s) and the device range in which the binary data in the device specified by (d) is stored.
- Processing is performed normally even if the device range in which the ASCII data to be converted and the device range for storing the converted binary data overlap.



- If the number of characters in the device specified by (n) is not a multiple of 4, "0H" is automatically stored after the specified number of the last device number among device numbers for storing the converted binary data.

### Ex.

When the number of characters in (n) is 9



(1) 0H is automatically stored.

- If the number of characters in the device specified by (n) is 0, no processing is performed.
- The ASCII code that can be specified by (s) must be in the range from "30H" to "39H" or "41H" to "46H".

## Operation error

| Error code (SD0) | Description                                                                                                                                                               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | A character other than hexadecimal numerical string (an ASCII code other than "30H" to "39H" and "41H" to "46H") is set in the device specified by (s).                   |
| 3285H            | Out-of-range data is set in the device specified by (n). <ul style="list-style-type: none"> <li>The specified number of characters is not between 0 and 16383.</li> </ul> |

# Converting single-precision real number to BCD format data

## EMOD(P)

These instructions convert single-precision real number data to the BCD floating point format data.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=EMOD(EN,s1,s2,d); ENO:=EMODP(EN,s1,s2,d);</pre> |
| FBD/LD |                                                           |
|        |                                                           |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| EMOD        |                     |
| EMODP       |                     |

### Setting data

### Description, range, data type

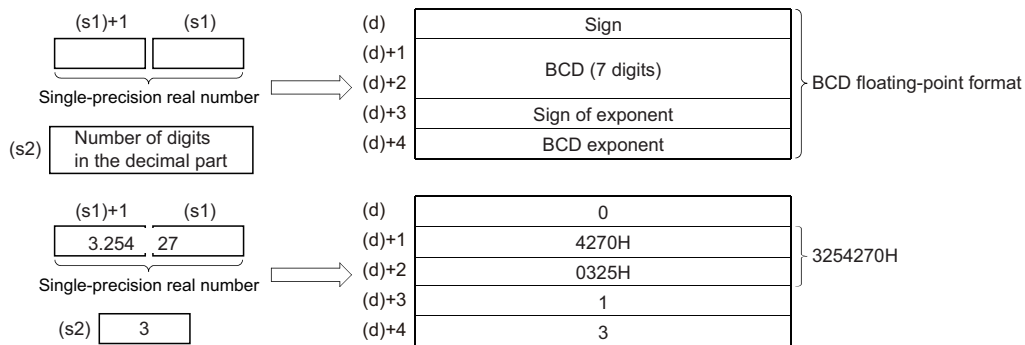
| Operand | Description                                                                                                 | Range                               | Data type                    | Data type (label)                      |
|---------|-------------------------------------------------------------------------------------------------------------|-------------------------------------|------------------------------|----------------------------------------|
| (s1)    | Single-precision real number data or the start device where the single-precision real number data is stored | $0, 2^{-126} \leq  (s1)  < 2^{128}$ | Single-precision real number | ANYREAL_32                             |
| (s2)    | Decimal part digit data                                                                                     | 0 to 7                              | 16-bit signed binary         | ANY16                                  |
| (d)     | Start device for storing the BCD format data                                                                | —                                   | 16-bit signed binary         | ANY16_ARRAY<br>(Number of elements: 5) |
| EN      | Execution condition                                                                                         | —                                   | Bit                          | BOOL                                   |
| ENO     | Execution result                                                                                            | —                                   | Bit                          | BOOL                                   |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

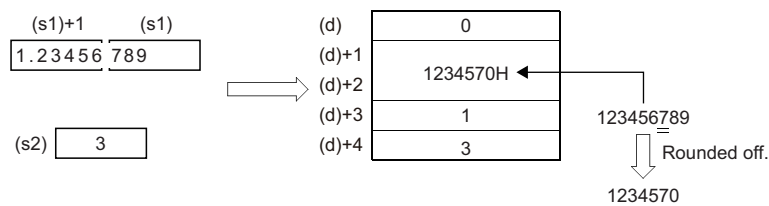
- These instructions convert the single-precision real number data stored in the device specified by (s1) to the BCD floating point format based on the number of decimal part digits stored in the device specified by (s2), and store the converted data in the device number specified by (d) and later.



- For the sign in (d) and the exponent sign in (d)+3, 0 is set for positive and 1 is set for negative.
- For the BCD exponent in (d)+4, a value between 0 and 38 is stored.
- The number of decimal part digits of the single-precision real number data in the device specified by (s1) is stored in the device specified by (s2). The example in the above figure shows the following.

3.25427  
 (s2)=3

- Six-digit BCD data, determined by rounding off the seventh digit, is stored in (d)+1 and (d)+2.



- A value of 0 to 7 can be set for the number of decimal part digits in the device specified by (s2).
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

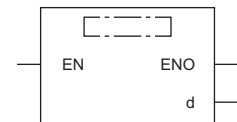
| Error code (SD0) | Description                                                                                                |
|------------------|------------------------------------------------------------------------------------------------------------|
| 3281H            | The number of decimal part digits in the device specified by (s2) is out of the range from 0 to 7.         |
| 3282H            | The value set to a device or label in (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

## Two's complement of 16-bit binary data (sign inversion)

### NEG(P)

Invert the sign of 16-bit binary device.

| Ladder | ST                                  |
|--------|-------------------------------------|
|        | ENO:=NEG(EN,d);<br>ENO:=NEGP(EN,d); |
| FBD/LD |                                     |



### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| NEG         |                     |
| NEGP        |                     |

### Setting data

### Description, range, data type

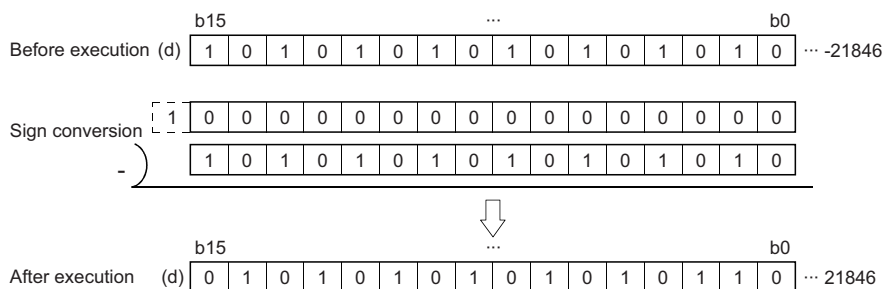
| Operand | Description                                                   | Range | Data type            | Data type (label) |
|---------|---------------------------------------------------------------|-------|----------------------|-------------------|
| (d)     | Device where the data subjected to two's complement is stored | —     | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                           | —     | Bit                  | BOOL              |
| ENO     | Execution result                                              | —     | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions invert the sign of the 16-bit binary data in the device specified by (d) and store the inverted data in the device specified by (d).
- The instructions are used to invert positive and negative signs.



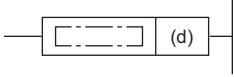
### Operation error

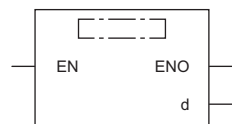
There is no operation error.

# Two's complement of 32-bit binary data (sign inversion)

## DNEG(P)

These instructions invert the sign of 32-bit binary device.

| Ladder                                                                            | ST                                    |
|-----------------------------------------------------------------------------------|---------------------------------------|
|  | ENO:=DNEG(EN,d);<br>ENO:=DNEGP(EN,d); |
| FBD/LD                                                                            |                                       |



## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DNEG        |  |
| DNEGP       |  |

## Setting data

## Description, range, data type

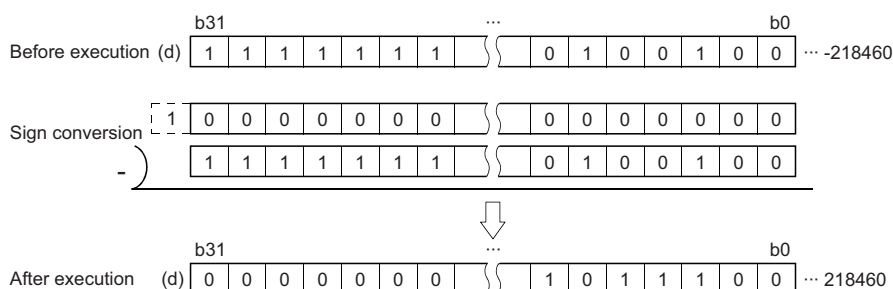
| Operand | Description                                                         | Range | Data type            | Data type (label) |
|---------|---------------------------------------------------------------------|-------|----------------------|-------------------|
| (d)     | Start device where the data subjected to two's complement is stored | —     | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                                 | —     | Bit                  | BOOL              |
| ENO     | Execution result                                                    | —     | Bit                  | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions invert the sign of the 32-bit binary data in the device specified by (d) and store the inverted data in the device specified by (d).
- The instructions are used to invert positive and negative signs.



## Operation error

There is no operation error.



## Decoding 8-bit data to 256-bit data

### DECO(P)

These instructions decode the lower (n) bits of the specified device.

| Ladder | ST                                                    |
|--------|-------------------------------------------------------|
|        | <pre>ENO:=DECO(EN,s,n,d); ENO:=DECOP(EN,s,n,d);</pre> |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DECO        |                     |
| DECOP       |                     |

### Setting data

### ■Description, range, data type

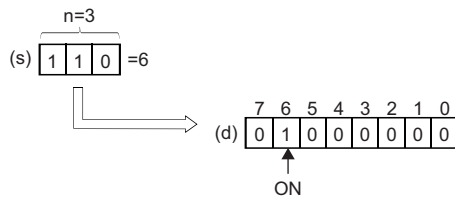
| Operand | Description                                                                   | Range  | Data type                | Data type (label) |
|---------|-------------------------------------------------------------------------------|--------|--------------------------|-------------------|
| (s)     | Decode data or the start number of the device where the decode data is stored | —      | Bit/16-bit signed binary | ANY_ELEMENTARY    |
| (d)     | Device for storing the decoded data                                           | —      | Bit/Word                 | ANY_ELEMENTARY    |
| (n)     | Effective bit length                                                          | 1 to 8 | 16-bit unsigned binary   | ANY16             |
| EN      | Execution condition                                                           | —      | Bit                      | BOOL              |
| ENO     | Execution result                                                              | —      | Bit                      | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions turn on the bit, corresponding to the binary value specified by the lower (n) bits in the device specified by (s), in the device specified by (d)



- Specify a value 1 to 8 for (n).
- When (n)=0, no processing is performed and the values in the device specified by (d) remain unchanged.
- A bit device is treated as 1 bit, and a word device is treated as 16 bits.

## Operation error

| Error code (SD0) | Description                                             |
|------------------|---------------------------------------------------------|
| 3281H            | The value specified by (n) is out of the range, 0 to 8. |

# Encoding 256-bit data to 8-bit data

## ENCO(P)

These instructions encode the bit data of 'n'th power of 2.

| Ladder | ST                                                    |
|--------|-------------------------------------------------------|
|        | <pre>ENO:=ENCO(EN,s,n,d); ENO:=ENCOP(EN,s,n,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ENCO        |                     |
| ENCOP       |                     |

### Setting data

### Description, range, data type

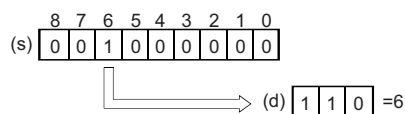
| Operand | Description                                             | Range  | Data type                | Data type (label) |
|---------|---------------------------------------------------------|--------|--------------------------|-------------------|
| (s)     | Device where the encode data is stored                  | —      | Bit/Word                 | ANY_ELEMENTARY    |
| (d)     | Start number of the device for storing the encoded data | —      | Bit/16-bit signed binary | ANY_ELEMENTARY    |
| (n)     | Effective bit length                                    | 1 to 8 | 16-bit unsigned binary   | ANY16             |
| EN      | Execution condition                                     | —      | Bit                      | BOOL              |
| ENO     | Execution result                                        | —      | Bit                      | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            | Z | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

### Processing details

- These instructions store the binary value, corresponding to the bit which is set to 1 in the  $2^{(n)}$  bit data in the device specified by (s), in the device specified by (d).



- Specify a value 1 to 8 for (n).
- When (n)=0, no processing is performed and the values in the device specified by (d) remain unchanged.
- A bit device is treated as 1 bit, and a word device is treated as 16 bits.
- When two or more bits are 1, the upper bit position is used for processing.

## Operation error

| Error code<br>(SD0) | Description                                                                   |
|---------------------|-------------------------------------------------------------------------------|
| 3281H               | The value specified by (n) is out of the range, 0 to 8.                       |
|                     | The bits in the $2^{(n)}$ bit data in the device specified by (s) are all 0s. |

## Decoding data to seven-segment display data

### SEG(P)

These instructions decode the data consisting of 0 to F specified by the lower 4 bits of the device to seven-segment display data.

| Ladder | ST                                      |
|--------|-----------------------------------------|
|        | ENO:=SEG(EN,s,d);<br>ENO:=SEGP(EN,s,d); |
| FBD/LD |                                         |
|        |                                         |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SEG         |                     |
| SEGP        |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                               | Range           | Data type            | Data type (label) |
|---------|-----------------------------------------------------------|-----------------|----------------------|-------------------|
| (s)     | Decode data or the device where the decode data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Device for storing the decoded data                       | —               | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                       | —               | Bit                  | BOOL              |
| ENO     | Execution result                                          | —               | Bit                  | BOOL              |

### ■Applicable devices

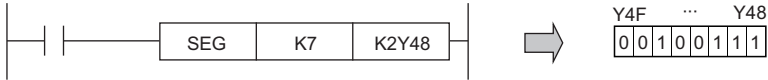
| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions decode the data consisting of 0 to F specified by the lower 4 bits in the device specified by (s) to seven-segment display data, and store the decoded data in the device specified by (d).
- In the case of a bit device, (d) indicates the start device for storing 7-segment display data. In the case of a word device, it indicates the device number for storing the data.

**Ex.**

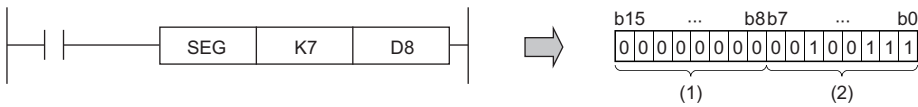
Bit device



The data in Y48 to Y4F does not change until the next data is output.

**Ex.**

Word device



(1) The upper 8 bits are filled with 0s.

(2) The seven-segment display data are stored in the lower 8 bits.

- The following is the truth table for the seven-segment display.

| (s)         |             | Seven-segment display | (d) |    |    |    |    |    |    |    | Display data |
|-------------|-------------|-----------------------|-----|----|----|----|----|----|----|----|--------------|
| Hexadecimal | Bit pattern |                       | b7  | b6 | b5 | b4 | b3 | b2 | b1 | b0 |              |
| 0           | 0000        |                       | 0   | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0            |
| 1           | 0001        |                       | 0   | 0  | 0  | 0  | 0  | 1  | 1  | 0  | 1            |
| 2           | 0010        |                       | 0   | 1  | 0  | 1  | 1  | 0  | 1  | 1  | 2            |
| 3           | 0011        |                       | 0   | 1  | 0  | 0  | 1  | 1  | 1  | 1  | 3            |
| 4           | 0100        |                       | 0   | 1  | 1  | 0  | 0  | 1  | 1  | 0  | 4            |
| 5           | 0101        |                       | 0   | 1  | 1  | 0  | 1  | 1  | 0  | 1  | 5            |
| 6           | 0110        |                       | 0   | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 6            |
| 7           | 0111        |                       | 0   | 0  | 1  | 0  | 0  | 1  | 1  | 1  | 7            |
| 8           | 1000        |                       | 0   | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 8            |
| 9           | 1001        |                       | 0   | 1  | 1  | 0  | 1  | 1  | 1  | 1  | 9            |
| A           | 1010        |                       | 0   | 1  | 1  | 1  | 0  | 1  | 1  | 1  | A            |
| B           | 1011        |                       | 0   | 1  | 1  | 1  | 1  | 1  | 0  | 0  | B            |
| C           | 1100        |                       | 0   | 0  | 1  | 1  | 1  | 0  | 0  | 1  | C            |
| D           | 1101        |                       | 0   | 1  | 0  | 1  | 1  | 1  | 1  | 0  | D            |
| E           | 1110        |                       | 0   | 1  | 1  | 1  | 1  | 0  | 0  | 1  | E            |
| F           | 1111        |                       | 0   | 1  | 1  | 1  | 0  | 0  | 0  | 1  | F            |

## Operation error

There is no operation error.

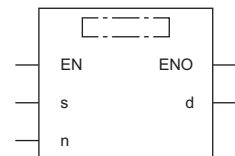
## Separating data in units of 4 bits

### DIS(P)

These instructions store the lower (n) nibble(s) of 16-bit binary data in another device range specified.

| Ladder | ST                                          |
|--------|---------------------------------------------|
|        | ENO:=DIS(EN,s,n,d);<br>ENO:=DISP(EN,s,n,d); |

### FBD/LD



### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DIS         |                     |
| DISP        |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                       | Range  | Data type              | Data type (label)   |
|---------|---------------------------------------------------|--------|------------------------|---------------------|
| (s)     | Device where the separation target data is stored | —      | 16-bit signed binary   | ANY16               |
| (d)     | Start device for storing the separated data       | —      | 16-bit signed binary   | ANY16* <sup>1</sup> |
| (n)     | Number of separation units                        | 1 to 4 | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                               | —      | Bit                    | BOOL                |
| ENO     | Execution result                                  | —      | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

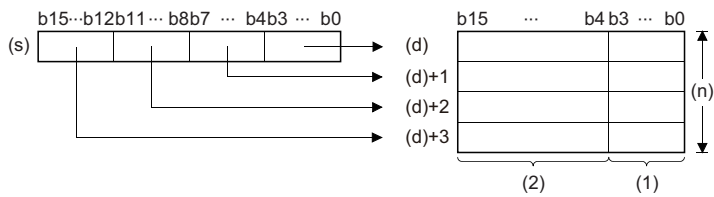
### ■Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |



## Processing details

- These instructions separate the lower (n) nibble(s) (4 bits/nibble) from the 16-bit binary data in the device specified by (s), and store each of the separated data in the lower 4 bits of the (n) points of data in the device specified by (d).



(1) Data storage area

(2) Filled with 0s.

- The upper 12 bits of the (n) points of data in the device specified by (d) are filled with 0s.
- Specify a value 1 to 4 for (n).
- When (n)=0, no processing is performed and the (n) points of data starting from the device specified by (d) remain unchanged.

## Operation error

| Error code (SD0) | Description                                             |
|------------------|---------------------------------------------------------|
| 3281H            | The value specified by (n) is out of the range, 0 to 4. |

## Combining data in units of 4 bits

### UNI(P)

These instructions store the lower 4 bits of the (n) points of 16-bit binary data in another 16-bit device.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | <pre>ENO:=UNI(EN,s,n,d); ENO:=UNIP(EN,s,n,d);</pre> |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| UNI         |                     |
| UNIP        |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                              | Range  | Data type              | Data type (label)   |
|---------|----------------------------------------------------------|--------|------------------------|---------------------|
| (s)     | Start device where the combination target data is stored | —      | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (d)     | Device for storing the combined data                     | —      | 16-bit signed binary   | ANY16               |
| (n)     | Number of combination units                              | 1 to 4 | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                      | —      | Bit                    | BOOL                |
| ENO     | Execution result                                         | —      | Bit                    | BOOL                |

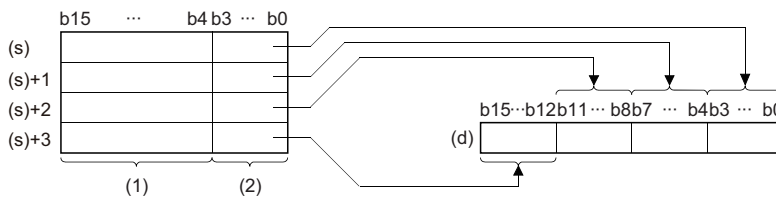
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions store the lower 4 bits of the (n) points of 16-bit binary data in the device specified by (s) in the 16-bit device specified by (d).



(1) Ignored.

(2) Data to be connected

- The upper bits (bits in the (4-n) nibble(s)) of data in the device specified by (d) are filled with 0s.
- Specify a value 1 to 4 for (n).
- When (n)=0, no processing is performed and the data in the device specified by (d) remain unchanged.

## Operation error

| Error code (SD0) | Description                                             |
|------------------|---------------------------------------------------------|
| 3281H            | The value specified by (n) is out of the range, 0 to 4. |

# Separating data in units of bits

## NDIS(P)

These instructions separate the data in units of bits. (The number of bits can be specified as desired.)

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=NDIS(EN,s1,s2,d); ENO:=NDISP(EN,s1,s2,d);</pre> |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| NDIS        |                     |
| NDISP       |                     |

## Setting data

## Description, range, data type

| Operand | Description                                             | Range | Data type            | Data type (label)   |
|---------|---------------------------------------------------------|-------|----------------------|---------------------|
| (s1)    | Start device where the separation target data is stored | —     | 16-bit signed binary | ANY16 <sup>*1</sup> |
| (d)     | Start device for storing the separated data             | —     | 16-bit signed binary | ANY16 <sup>*1</sup> |
| (s2)    | Start device for storing the separation unit            | —     | 16-bit signed binary | ANY16 <sup>*1</sup> |
| EN      | Execution condition                                     | —     | Bit                  | BOOL                |
| ENO     | Execution result                                        | —     | Bit                  | BOOL                |

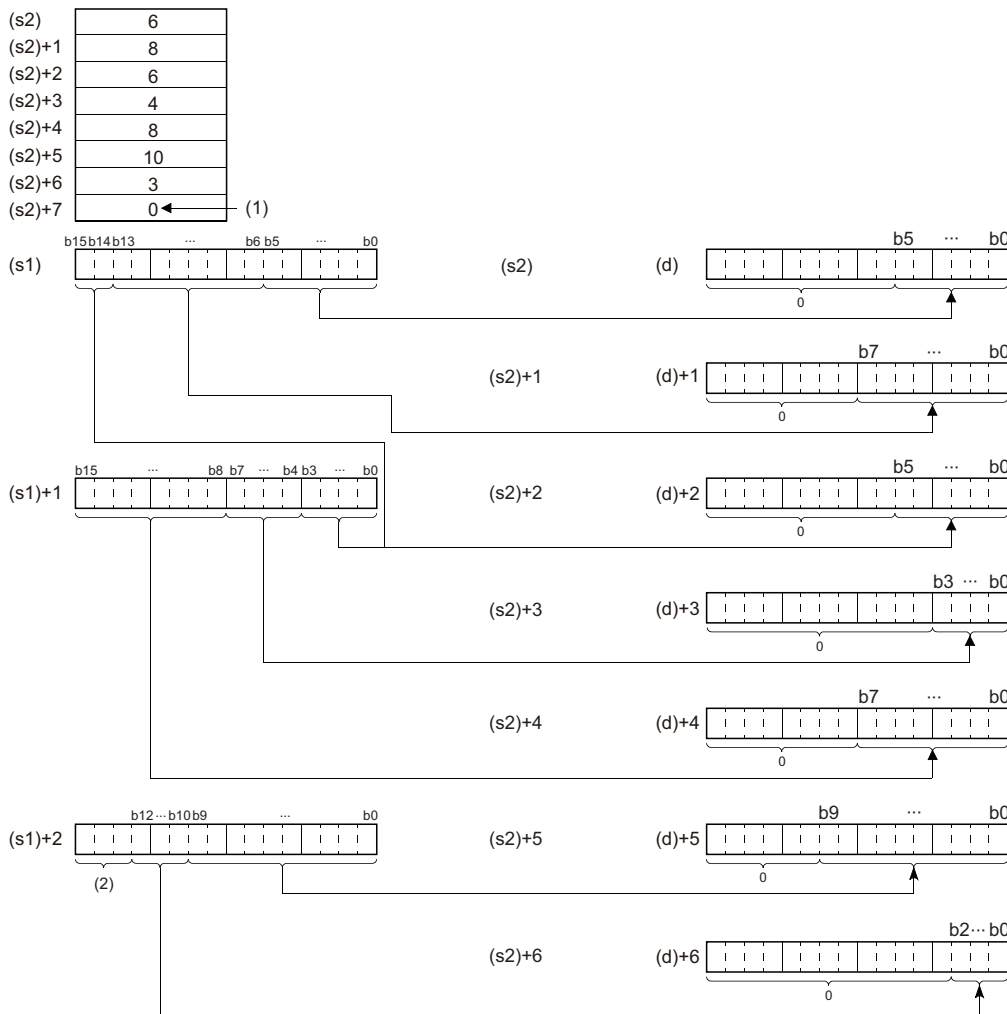
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions separate the bits of data in the device specified by (s1) and later in units of bits specified by (s2), and store the separated data in the device range specified by (d) and later.



(s2) to (s2)+6: Number of bits specified by (s2) to (s2)+6

(1) The value, 0, indicates the end of setting.

(2) Ignored.

- Specify the value 1 to 16 for (s2).
- The device areas from the one specified by (s2) to the one storing "0" are processed.
- Specify the devices so that the range of the device where the separation target data is stored ((s1) and later) and the range of the device for storing the separated data ((d) and later) do not overlap. If they overlap, a correct operation result may not be obtained.
- Do not overlap the device numbers that are specified by (s1), (s2), and (d).

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                    |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The device ranges specified by (s1) and (s2) are overlapping.                                                                                                                                                                  |
|                  | The device ranges specified by (s1) and (d) are overlapping.                                                                                                                                                                   |
|                  | The device ranges specified by (s2) and (d) are overlapping.                                                                                                                                                                   |
| 3281H            | Invalid data that cannot be converted are input in (s2).                                                                                                                                                                       |
|                  | <ul style="list-style-type: none"> <li>The value specified is out of the range, 1 to 16.</li> <li>There is no 0 set between the specified device and the last of the assignment range of the relevant device/label.</li> </ul> |

## Combining data in units of bits

### NUNI(P)

These instructions combine the data in units of bits. (The number of bits can be specified as desired.)

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=NUNI(EN,s1,s2,d); ENO:=NUNIP(EN,s1,s2,d);</pre> |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| NUNI        |                     |
| NUNIP       |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                              | Range | Data type            | Data type (label)   |
|---------|----------------------------------------------------------|-------|----------------------|---------------------|
| (s1)    | Start device where the combination target data is stored | —     | 16-bit signed binary | ANY16 <sup>*1</sup> |
| (d)     | Start device for storing the combined data               | —     | 16-bit signed binary | ANY16 <sup>*1</sup> |
| (s2)    | Start device for storing the combination unit            | —     | 16-bit signed binary | ANY16 <sup>*1</sup> |
| EN      | Execution condition                                      | —     | Bit                  | BOOL                |
| ENO     | Execution result                                         | —     | Bit                  | BOOL                |

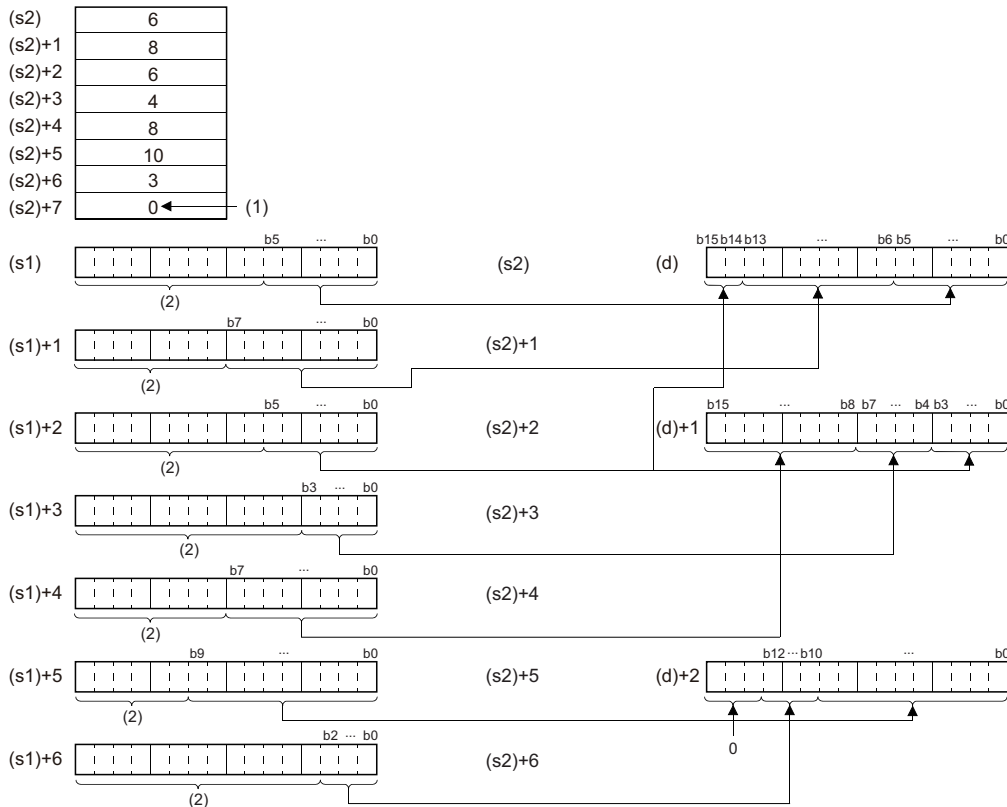
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions combine the bits of data in the device specified by (s1) and later in units of bits specified by (s2), and store the combined data in the device specified by (d) and later.



(s2) to (s2)+6: Number of bits specified by (s2) to (s2)+6

(1) The value, 0, indicates the end of setting.

(2) Ignored.

- Specify the value 1 to 16 for (s2).
- The device areas from the one specified by (s2) to the one storing "0" are processed.
- Specify the devices so that the range of the device where the combination target data is stored ((s1) and later) and the range of the device for storing the combined data ((d) and later) do not overlap. If they overlap, a correct operation result may not be obtained.
- Do not overlap the device numbers that are specified by (s1), (s2), and (d).

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                    |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The device ranges specified by (s1) and (s2) are overlapping.                                                                                                                                                                  |
|                  | The device ranges specified by (s1) and (d) are overlapping.                                                                                                                                                                   |
|                  | The device ranges specified by (s2) and (d) are overlapping.                                                                                                                                                                   |
| 3281H            | Invalid data that cannot be converted are input in (s2).                                                                                                                                                                       |
|                  | <ul style="list-style-type: none"> <li>The value specified is out of the range, 1 to 16.</li> <li>There is no 0 set between the specified device and the last of the assignment range of the relevant device/label.</li> </ul> |

## Separating data in units of bytes

### WTOB(P)

These instructions separate 16-bit binary data into (n) bytes.

| Ladder | ST                                            |
|--------|-----------------------------------------------|
|        | ENO:=WTOB(EN,s,n,d);<br>ENO:=WTOBP(EN,s,n,d); |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| WTOB        |                     |
| WTOBP       |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                             | Range      | Data type              | Data type (label)   |
|---------|---------------------------------------------------------|------------|------------------------|---------------------|
| (s)     | Start device where the separation target data is stored | —          | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (d)     | Start device for storing the separated data             | —          | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (n)     | Number of data bytes to be separated                    | 0 to 65535 | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                     | —          | Bit                    | BOOL                |
| ENO     | Execution result                                        | —          | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

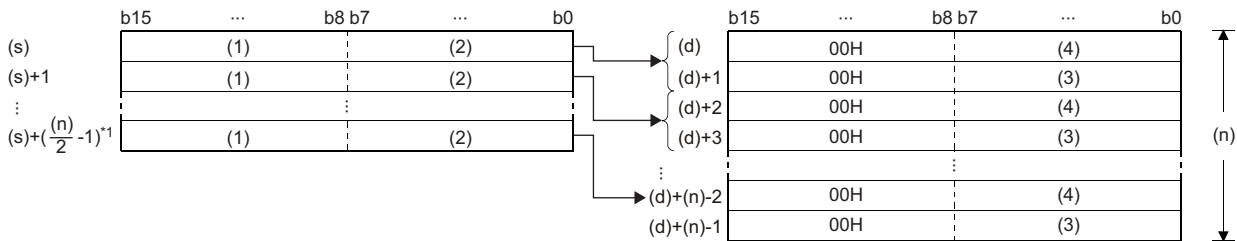
### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |



## Processing details

- These instructions separate the 16-bit binary data in the device specified by (s) and later into (n) bytes, and store the separated data in the device specified by (d) and later.

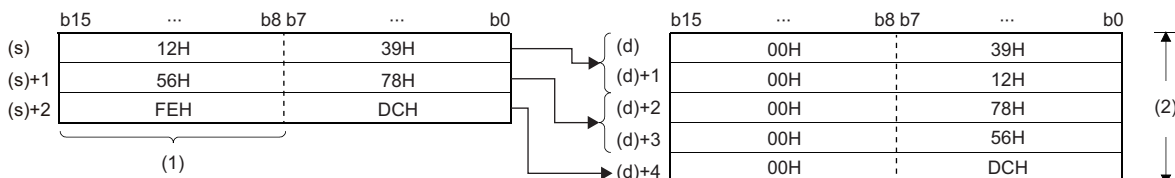


- (1) Upper byte  
 (2) Lower byte  
 (3) Upper byte data  
 (4) Lower byte data

\*1 Values after the decimal point are rounded up.

### Ex.

When (n) is 5, the data in the device specified by (s) (upper 8 bits) to (s)+2 (lower 8 bits) are stored in the device specified by (d) to (d)+4.

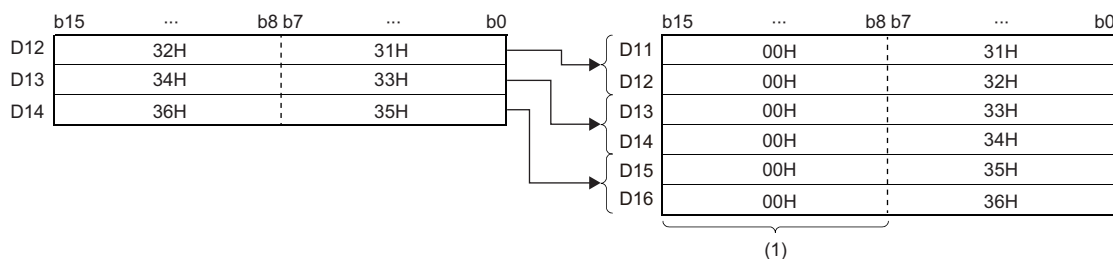


- (1) The data, FEH, is ignored when (n) is 5.  
 (2) When (n) is 5

- Setting the number of bytes for (n) automatically determines the range of 16-bit binary data specified by (s) and the range of the device specified by (d) for storing the separated data.
- If (n) is 0, no processing is performed.
- The upper 8 bits of the device specified by (d) are automatically filled with 00Hs.

### Ex.

When the byte data in D12 to D14 are stored in the lower 8 bits of D11 to D16



- (1) 00H is automatically stored.

- Even when the ranges of the device where the separation target data is stored and the device for storing the separated data overlap, the processing is performed normally.

| Range of the device where the separation target data is stored | Range of the device for storing the separated data |
|----------------------------------------------------------------|----------------------------------------------------|
| (s) to (s)+( $\frac{(n)}{2}-1$ )                               | (d)+0 to (d)+(n)-1                                 |

## Operation error

There is no operation error.

## Combining data in units of bytes

### BTOW(P)

These instructions combine the lower 8 bits of 16-bit binary data in units of words.

| Ladder | ST                                            |
|--------|-----------------------------------------------|
|        | ENO:=BTOW(EN,s,n,d);<br>ENO:=BTOWP(EN,s,n,d); |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BTOW        |                     |
| BTOWP       |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                              | Range      | Data type              | Data type (label)   |
|---------|----------------------------------------------------------|------------|------------------------|---------------------|
| (s)     | Start device where the combination target data is stored | —          | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (d)     | Start device for storing the combined data               | —          | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| (n)     | Number of data bytes to be combined                      | 0 to 65535 | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                      | —          | Bit                    | BOOL                |
| ENO     | Execution result                                         | —          | Bit                    | BOOL                |

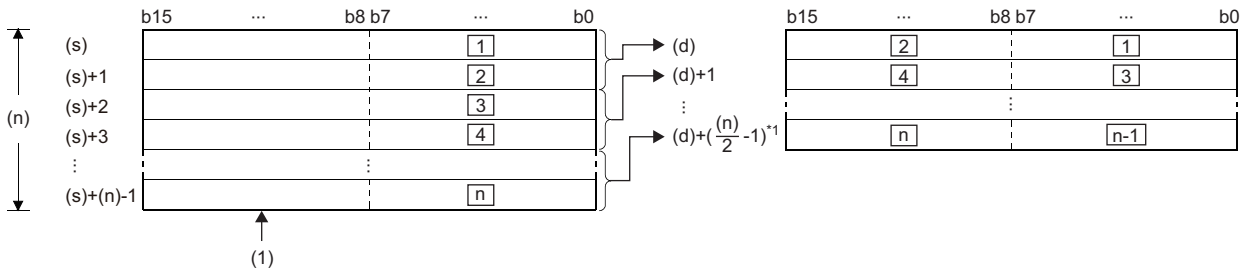
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions combine the (n) bytes of lower 8 bits of 16-bit binary data in the device specified by (s) and later in units of words, and store the combined data in the device specified by (d) and later.
- The (n) bytes of upper 8 bits of 16-bit binary data in the device specified by (s) and later are ignored. When (n) is an odd number, the upper 8 bits of the device where 'n'th-byte data is stored are filled with 0s.



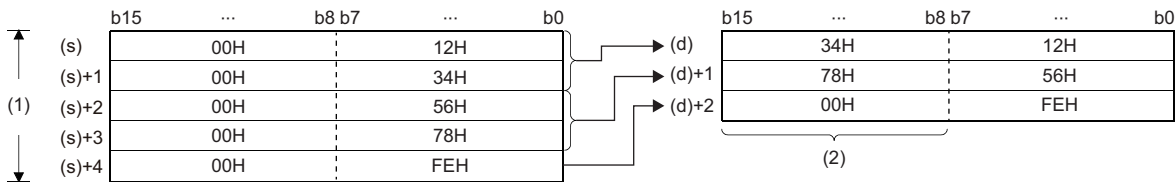
□: □th byte data

(1) The upper byte data are ignored.

\*1 Values after the decimal point are rounded up.

**Ex.**

When (n) is 5, the lower 8 bits of the data in the device specified by (s) to (s)+4 are combined and stored in the device specified by (d) to (d)+2.



(1) When (n) is 5

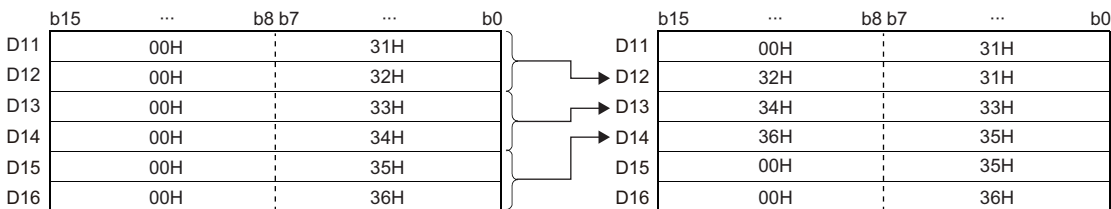
(2) Filled with 00H.

- Setting the number of bytes for (n) automatically determines the range of byte data in the device specified by (s) and the range of the device specified by (d) for storing the combined data.
- If (n) is 0, no processing is performed.
- The upper 8 bits in the device specified by (s) and later are ignored, and only the lower 8 bits are processed.
- Even when the ranges of the device where the combination target data is stored and the device for storing the combined data overlap, the processing is performed normally.

| Range of the device where the combination target data is stored | Range of the device for storing the combined data |
|-----------------------------------------------------------------|---------------------------------------------------|
| (s)+0 to (s)+(n)-1                                              | (d) to (d)+( $\frac{(n)}{2}-1$ )                  |

**Ex.**

When the lower 8 bits of D11 to D16 are stored in D12 to D14



## Operation error

There is no operation error.

# 12.7 Data Transfer Instructions

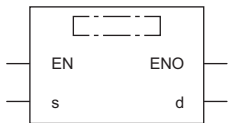
## Transferring 16-bit binary data

### MOV(P)

These instructions transfer the 16-bit binary data in the device specified.

| Ladder | ST                                        |
|--------|-------------------------------------------|
|        | ENO:=MOV(EN,s,d);<br>ENO:=MOV(P)(EN,s,d); |

### FBD/LD



### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| MOV         |                     |
| MOV(P)      |                     |

### Setting data

### Description, range, data type

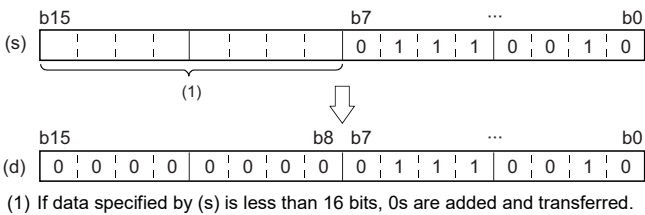
| Operand | Description                                                                               | Range           | Data type            | Data type (label) |
|---------|-------------------------------------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s)     | Transfer source data or the number of the device where the transfer source data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Transfer destination device number                                                        | —               | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                                       | —               | Bit                  | BOOL              |
| ENO     | Execution result                                                                          | —               | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions transfer the 16-bit binary data in the device specified by (s) to the device specified by (d).
- If (s) is a digit-specified bit device, the digit-specified bits are targeted. If data specified by (s) is less than 16 bits, 0s are added and transferred.





## Operation error

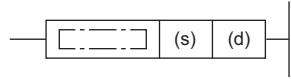
There is no operation error.

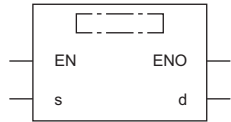
12

# Transferring 32-bit binary data

## DMOV(P)

These instructions transfer the 32-bit binary data in the device specified.

| Ladder                                                                            | ST                                       |
|-----------------------------------------------------------------------------------|------------------------------------------|
|  | ENO:=DMOV(EN,s,d);<br>ENO:=DMOVP(EN,s,d) |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DMOV        |  |
| DMOVP       |  |

### Setting data

### Description, range, data type

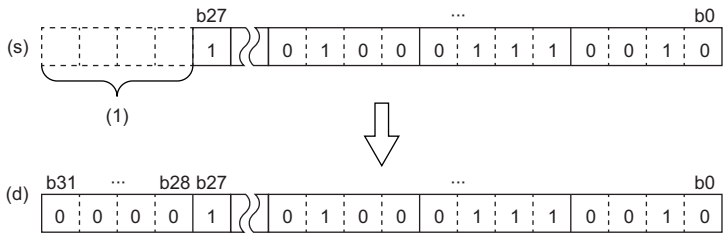
| Operand | Description                                                                               | Range                     | Data type            | Data type (label) |
|---------|-------------------------------------------------------------------------------------------|---------------------------|----------------------|-------------------|
| (s)     | Transfer source data or the number of the device where the transfer source data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)     | Transfer destination device number                                                        | —                         | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                                                       | —                         | Bit                  | BOOL              |
| ENO     | Execution result                                                                          | —                         | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions transfer the 32-bit binary data in the device specified by (s) to the device specified by (d).
- If (s) is a digit-specified bit device, the digit-specified bits are targeted. If data specified by (s) is less than 16 bits, 0s are added and transferred.



## Operation error

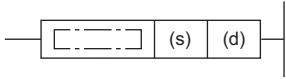
There is no operation error.

12

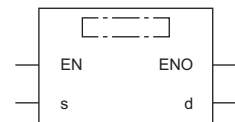
# Inverting and transferring 16-bit binary data

## CML(P)

These instructions invert the specified 16-bit binary data bit by bit, and transfer the inverted data.

| Ladder                                                                            | ST                                              |
|-----------------------------------------------------------------------------------|-------------------------------------------------|
|  | <pre>ENO:=CML(EN,s,d); ENO:=CMLP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| CML         |  |
| CMLP        |  |

## Setting data

## Description, range, data type

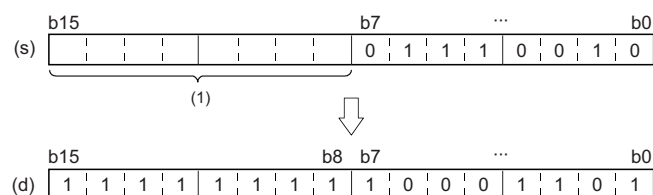
| Operand | Description                                                                                 | Range           | Data type            | Data type (label) |
|---------|---------------------------------------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s)     | Inversion target data or the number of the device where the inversion target data is stored | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Number of the device for storing the inverted data                                          | —               | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                                         | —               | Bit                  | BOOL              |
| ENO     | Execution result                                                                            | —               | Bit                  | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             | Z | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions invert the 16-bit binary data in the device specified by (s) bit by bit, and transfer the inverted data to the device specified by (d).
- If (s) is a digit-specified bit device, the digit-specified bits are targeted. If data specified by (s) is less than 16 bits, 0s are added and inverted.



(1) If data specified by (s) is less than 16 bits, 0s are added and inverted.

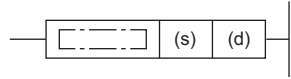
## Operation error

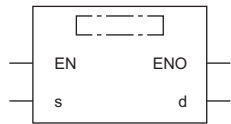
There is no operation error.

# Inverting and transferring 32-bit binary data

## DCML(P)

These instructions invert the specified 32-bit binary data bit by bit, and transfer the inverted data.

| Ladder                                                                            | ST                                        |
|-----------------------------------------------------------------------------------|-------------------------------------------|
|  | ENO:=DCML(EN,s,d);<br>ENO:=DCMLP(EN,s,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DCML        |  |
| DCMLP       |  |

### Setting data

#### Description, range, data type

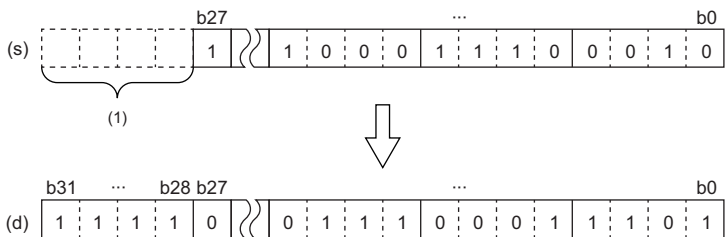
| Operand | Description                                                                                 | Range                     | Data type            | Data type (label) |
|---------|---------------------------------------------------------------------------------------------|---------------------------|----------------------|-------------------|
| (s)     | Inversion target data or the number of the device where the inversion target data is stored | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)     | Number of the device for storing the inverted data                                          | —                         | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                                                         | —                         | Bit                  | BOOL              |
| ENO     | Execution result                                                                            | —                         | Bit                  | BOOL              |

#### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions invert the 32-bit binary data in the device specified by (s) bit by bit, and transfer the inverted data to the device specified by (d).
- If (s) is a digit-specified bit device, the digit-specified bits are targeted. If data specified by (s) is less than 16 bits, 0s are added and inverted.



(1) If data specified by (s) is less than 32 bits, 0s are added and inverted.

## Operation error

There is no operation error.

12

# Inverting and transferring 1-bit data

## CMLB(P)

These instructions invert the specified bit data, and transfer the inverted data.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | <pre>ENO:=CMLB(EN,s,d); ENO:=CMLBP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| CMLB        |                     |
| CMLBP       |                     |

## Setting data

## Description, range, data type

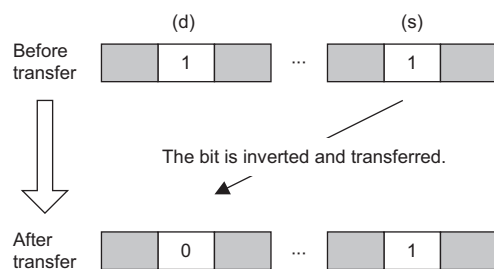
| Operand | Description                                                                                 | Range | Data type | Data type (label) |
|---------|---------------------------------------------------------------------------------------------|-------|-----------|-------------------|
| (s)     | Inversion target data or the number of the device where the inversion target data is stored | —     | Bit       | ANY_BOOL          |
| (d)     | Transfer destination device number                                                          | —     | Bit       | ANY_BOOL          |
| EN      | Execution condition                                                                         | —     | Bit       | BOOL              |
| ENO     | Execution result                                                                            | —     | Bit       | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions invert the bit data in the device specified by (s), and transfer the inverted data to the device specified by (d).





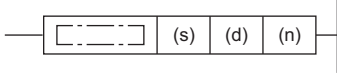
## Operation error

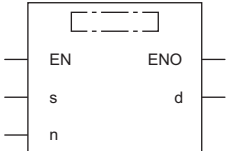
There is no operation error.

# Transferring 16-bit binary data block (16 bits)

## BMOV(P)

These instructions batch-transfer the (n) points (0 to 65535) of 16-bit binary data starting from the device specified.

| Ladder                                                                            | ST                                              |
|-----------------------------------------------------------------------------------|-------------------------------------------------|
|  | ENO:=BMOV(EN,s,n,d);<br>ENO:=BMOV(P)(EN,s,n,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| BMOV        |  |
| BMOV(P)     |  |

## Setting data

## Description, range, data type

| Operand | Description                                           | Range      | Data type              | Data type (label)     |
|---------|-------------------------------------------------------|------------|------------------------|-----------------------|
| (s)     | Start device where the transfer target data is stored | —          | 16-bit signed binary   | ANY16 <sup>*1*2</sup> |
| (d)     | Transfer destination start device                     | —          | 16-bit signed binary   | ANY16 <sup>*1*2</sup> |
| (n)     | Number of transfer data points                        | 0 to 65535 | 16-bit unsigned binary | ANY16 <sup>*2</sup>   |
| EN      | Execution condition                                   | —          | Bit                    | BOOL                  |
| ENO     | Execution result                                      | —          | Bit                    | BOOL                  |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

\*2 Data types other than INT and WORD are also available. (Except for BOOL, POINTER, and STRUCT data types (structures)). Note that available data types are INT and WORD (in range of ANY16) when "Yes" is selected for "Check the data type of instruction argument" of option settings.

For the option settings, refer to the following.

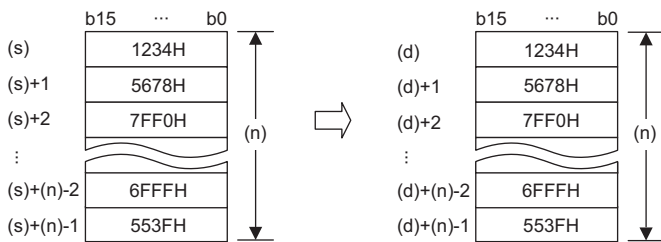
 GX Works3 Operating Manual

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | — | ○           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | — | ○           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

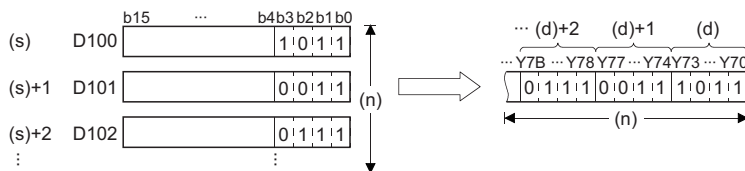
- These instructions batch-transfer the (n) points of 16-bit binary data starting from the device specified by (s) to the device specified by (d).



- Data can be transferred even when the transfer source device and destination device overlap. A transfer to smaller device numbers begins from the device specified by (s), and a transfer to larger device numbers begins from the device specified by (s)+(n)-1.
- When (s) is a word device and (d) is a bit device, the number of digit-specified bits in the word device is transferred.

### Ex.

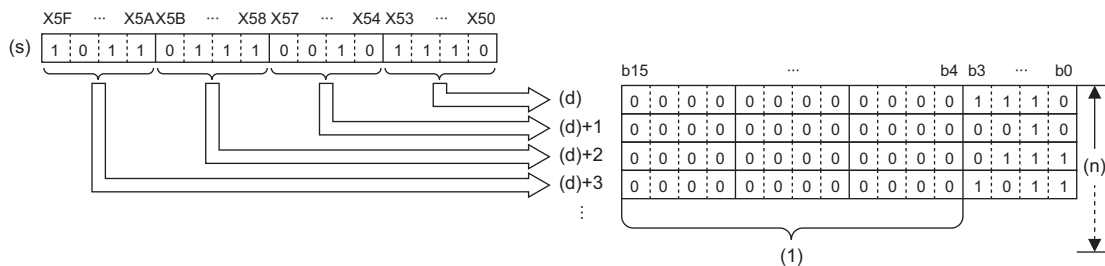
When K1Y70 is specified in (d), the lower 4 bits of the word device specified by (s) are transferred.



- When (s) is a digit-specified bit device and (d) is a word device, the number of digit-specified bits in the word device is transferred.

### Ex.

When K1X50 is specified in (s), the data is transferred to the lower 4 bits of the word device specified by (d).



(1) Filled with 0s.

- When both (s) and (d) are bit devices, set the same number of digits for both devices.
- The link direct device, module access device, and CPU buffer memory access device cannot be specified by both (s) and (d) in one instruction. Specify any one of those for either (s) or (d).

## Operation error

| Error code (SD0) | Description                                                                                                        |
|------------------|--------------------------------------------------------------------------------------------------------------------|
| 3290H            | The link direct device, module access device, or CPU buffer memory access device is specified by both (s) and (d). |

# Transferring 16-bit binary data block (32 bits)

## BMOVL(P)

These instructions batch-transfer the (n) points (1 to 4294967295) of 16-bit binary data starting from the device specified.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | ENO:=BMOVL(EN,s,n,d);<br>ENO:=BMOVLP(EN,s,n,d); |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BMOVL       |                     |
| BMOVLP      |                     |

## Setting data

## Description, range, data type

| Operand | Description                                           | Range           | Data type              | Data type (label) |
|---------|-------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Start device where the transfer target data is stored | —               | 16-bit signed binary   | ANY16*1           |
| (d)     | Transfer destination start device                     | —               | 16-bit signed binary   | ANY16*1           |
| (n)     | Number of transfer data points                        | 0 to 4294967295 | 32-bit unsigned binary | ANY32             |
| EN      | Execution condition                                   | —               | Bit                    | BOOL              |
| ENO     | Execution result                                      | —               | Bit                    | BOOL              |

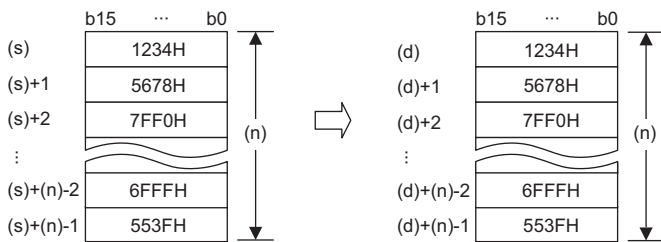
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○         | — | ○           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | — | ○           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |

## Processing details

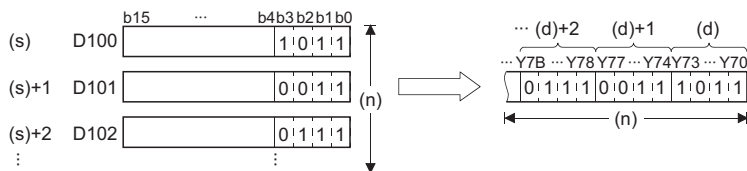
- These instructions batch-transfer the (n) points of 16-bit binary data starting from the device specified by (s) to the device specified by (d).



- Data can be transferred even when the transfer source device and destination device overlap. A transfer to smaller device numbers begins from the device specified by (s), and a transfer to larger device numbers begins from the device specified by (s)+(n)-1.
- When (s) is a word device and (d) is a bit device, the number of digit-specified bits in the word device is transferred.

### Ex.

When K1Y70 is specified in (d), the lower 4 bits of the word device specified by (s) are transferred.



- When both (s) and (d) are bit devices, set the same number of digits for both devices.
- To use the link direct device, module access device, or CPU buffer memory access device for (s) or (d), specify it only for one of the devices.

## Operation error

| Error code (SD0) | Description                                                                                                        |
|------------------|--------------------------------------------------------------------------------------------------------------------|
| 3290H            | The link direct device, module access device, or CPU buffer memory access device is specified by both (s) and (d). |

# Transferring the same 16-bit binary data block (16 bits)

## FMOV(P)

These instructions transfer 16-bit binary data to the (n) points (0 to 65535) starting from the device specified.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | ENO:=FMOV(EN,s,n,d);<br>ENO:=FMOV(P)(EN,s,n,d); |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| FMOV        |                     |
| FMOV(P)     |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                 | Range           | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Transfer target data or the device where the transfer target data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16             |
| (d)     | Transfer destination start device                                           | —               | 16-bit signed binary   | ANY16*1           |
| (n)     | Number of transfer data points                                              | 0 to 65535      | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition                                                         | —               | Bit                    | BOOL              |
| ENO     | Execution result                                                            | —               | Bit                    | BOOL              |

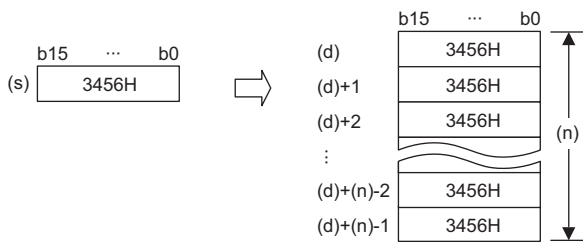
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

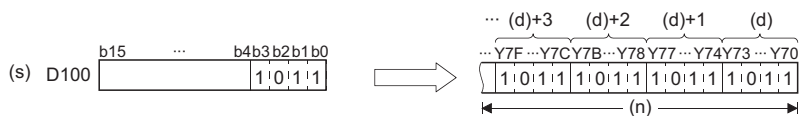
- These instructions transfer the 16-bit binary data in the device specified by (s) to the (n) points of the device specified by (d).



- When (s) is a word device and (d) is a bit device, the number of digit-specified bits in the word device is transferred.

### Ex.

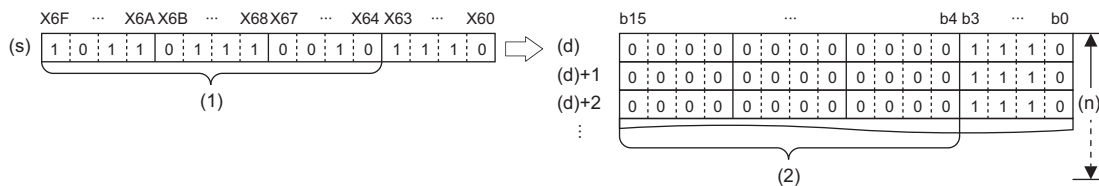
When K1Y70 is specified in (d), the lower 4 bits of the word device specified by (s) are transferred.



- When (s) is a digit-specified bit device and (d) is a word device, the number of digit-specified bits in the word device is transferred.

### Ex.

When K1X60 is specified in (s), the data is transferred to the lower 4 bits of the word device specified by (d).



(1) Ignored.

(2) Filled with 0s.

- When both (s) and (d) are bit devices, set the same number of digits for both devices.

## Operation error

There is no operation error.

## Transferring the same 16-bit binary data block (32 bits)

### FMOVL(P)

These instructions transfer 16-bit binary data to the (n) points (1 to 4294967295) starting from the device specified.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | ENO:=FMOVL(EN,s,n,d);<br>ENO:=FMOVLP(EN,s,n,d); |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| FMOVL       |                     |
| FMOVLP      |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                                                 | Range           | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Transfer target data or the device where the transfer target data is stored | -32768 to 32767 | 16-bit signed binary   | ANY16             |
| (d)     | Transfer destination start device                                           | —               | 16-bit signed binary   | ANY16*1           |
| (n)     | Number of transfer data points                                              | 0 to 4294967295 | 32-bit unsigned binary | ANY32             |
| EN      | Execution condition                                                         | —               | Bit                    | BOOL              |
| ENO     | Execution result                                                            | —               | Bit                    | BOOL              |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

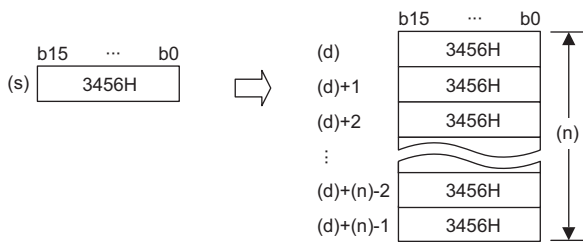
### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |



## Processing details

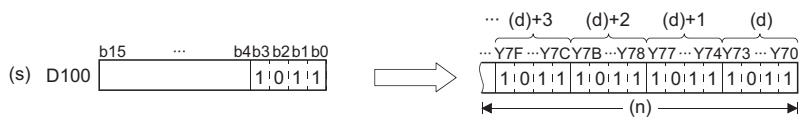
- These instructions transfer the 16-bit binary data in the device specified by (s) to the (n) points of the device specified by (d).



- When (s) is a word device and (d) is a bit device, the number of digit-specified bits in the word device is transferred.

### Ex.

When K1Y70 is specified in (d), the lower 4 bits of the word device specified by (s) are transferred.



- When both (s) and (d) are bit devices, set the same number of digits for both devices.

## Operation error

There is no operation error.

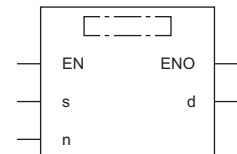
## Transferring the same 32-bit binary data block (16 bits)

### DFMOV(P)

These instructions transfer 32-bit binary data to the (n) points (1 to 65535) starting from the device specified.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | ENO:=DFMOV(EN,s,n,d);<br>ENO:=DFMOV(P)(EN,s,n,d); |

### FBD/LD



### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DFMOV       |                     |
| DFMOV(P)    |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                                                       | Range                     | Data type              | Data type (label)   |
|---------|-----------------------------------------------------------------------------------|---------------------------|------------------------|---------------------|
| (s)     | Transfer target data or the start device where the transfer target data is stored | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32               |
| (d)     | Transfer destination start device                                                 | —                         | 32-bit signed binary   | ANY32 <sup>*1</sup> |
| (n)     | Number of transfer data points                                                    | 0 to 65535                | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                                               | —                         | Bit                    | BOOL                |
| ENO     | Execution result                                                                  | —                         | Bit                    | BOOL                |

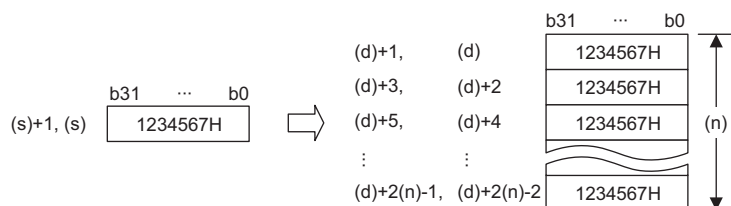
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

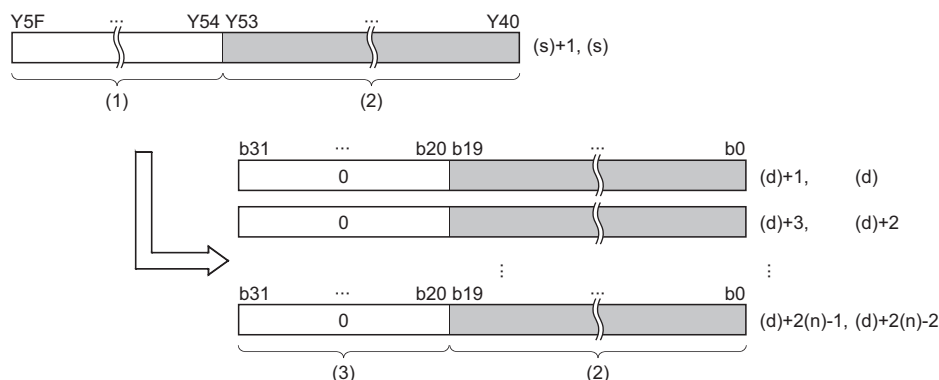
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | — | ○           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions transfer the 32-bit binary data in the device specified by (s) to the (n) points of the device specified by (d).

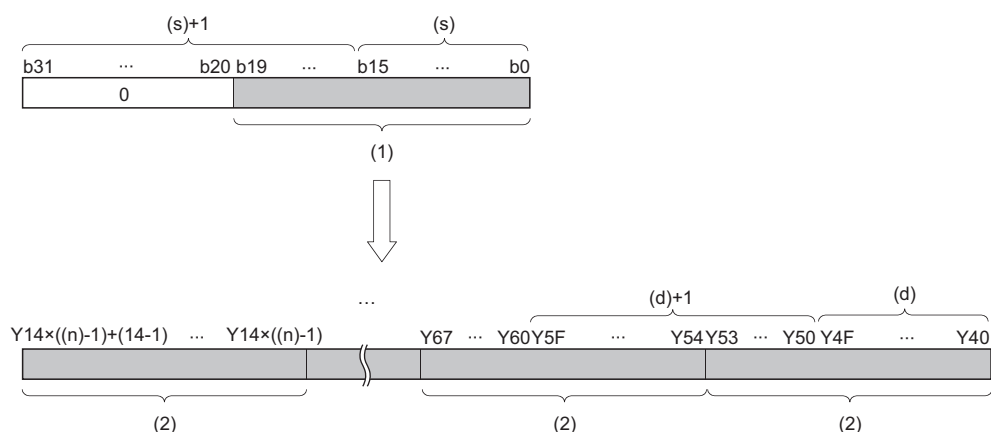


- When the number of digits is specified for the data in the device specified by (s), only the data corresponding to the specified digits are transferred. When K5Y40 is specified in (s), the lower 20 bits (five digits) of the word device specified by (s) are transferred.



- (1) Ignored.  
 (2) Data of 20 bits (5 digits)  
 (3) Filled with 0s.

- When the number of digits is specified for the data in the device specified by (d), the data corresponding to the specified digits are transferred. When K5Y40 is specified in (d), the lower 20 bits of the device specified by (s) are transferred. When the number of digits is specified for both data in the devices specified by (s) and (d), the data corresponding to the digits specified in (d) are transferred.



- (1) Data (20 bits (5 digits)) specified by (d)  
 (2) Data of 20 bits (5 digits)

- If (n) is 0, no processing is performed.

## Operation error

There is no operation error.

## Transferring the same 32-bit binary data block (32 bits)

### DFMOVL(P)

These instructions transfer 32-bit binary data to the (n) points (1 to 4294967295) starting from the device specified.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=DFMOVL(EN,s,n,d); ENO:=DFMOVLP(EN,s,n,d);</pre> |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DFMOVL      |                     |
| DFMOVLP     |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                                                       | Range                     | Data type              | Data type (label)   |
|---------|-----------------------------------------------------------------------------------|---------------------------|------------------------|---------------------|
| (s)     | Transfer target data or the start device where the transfer target data is stored | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32               |
| (d)     | Transfer destination start device                                                 | —                         | 32-bit signed binary   | ANY32 <sup>*1</sup> |
| (n)     | Number of transfer data points                                                    | 0 to 4294967295           | 32-bit unsigned binary | ANY32               |
| EN      | Execution condition                                                               | —                         | Bit                    | BOOL                |
| ENO     | Execution result                                                                  | —                         | Bit                    | BOOL                |

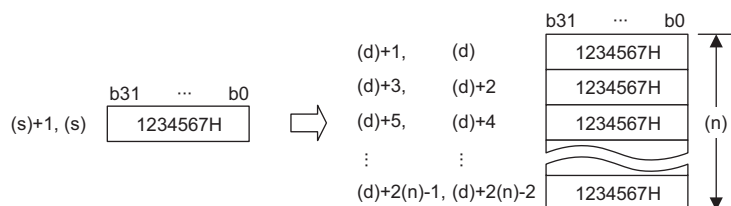
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

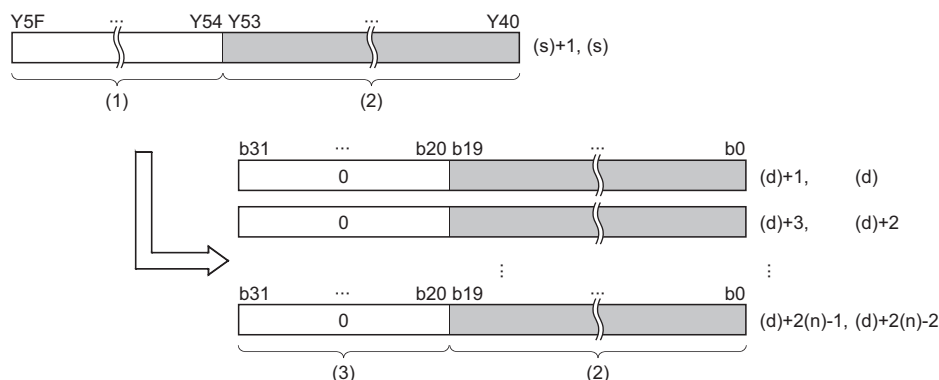
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | — | ○           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions transfer the 32-bit binary data in the device specified by (s) to the (n) points of the device specified by (d).

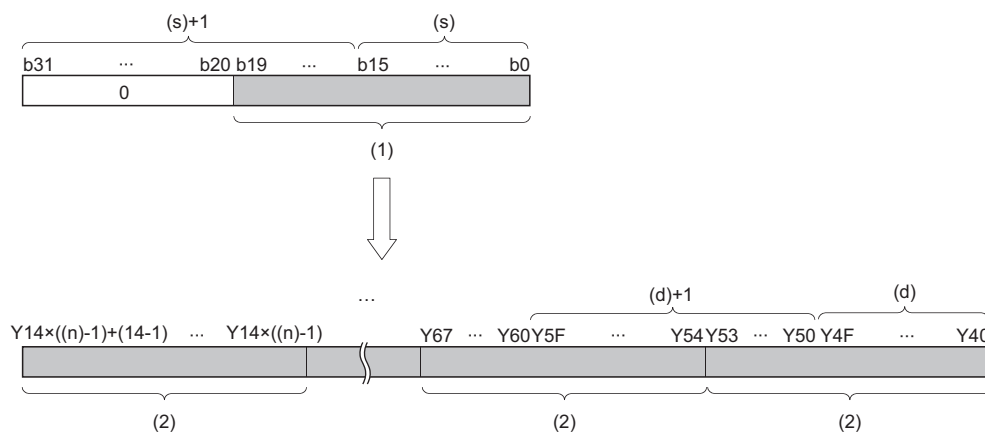


- When the number of digits is specified for the data in the device specified by (s), only the data corresponding to the specified digits are transferred. When K5Y40 is specified in (s), the lower 20 bits (five digits) of the word device specified by (s) are transferred.



- (1) Ignored.  
 (2) Data of 20 bits (5 digits)  
 (3) Filled with 0s.

- When the number of digits is specified for the data in the device specified by (d), the data corresponding to the specified digits are transferred. When K5Y40 is specified in (d), the lower 20 bits of the device specified by (s) are transferred. When the number of digits is specified for both data in the devices specified by (s) and (d), the data corresponding to the digits specified in (d) are transferred.



- (1) Data (20 bits (5 digits)) specified by (d)  
 (2) Data of 20 bits (5 digits)

- If (n) is 0, no processing is performed.

## Operation error

There is no operation error.

# Exchanging 16-bit binary data

## XCH(P)

These instructions exchange the 16-bit binary data specified.

| Ladder | ST                                          |
|--------|---------------------------------------------|
|        | ENO:=XCH(EN,d1,d2);<br>ENO:=XCHP(EN,d1,d2); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| XCH         |                     |
| XCHP        |                     |

### Setting data

### Description, range, data type

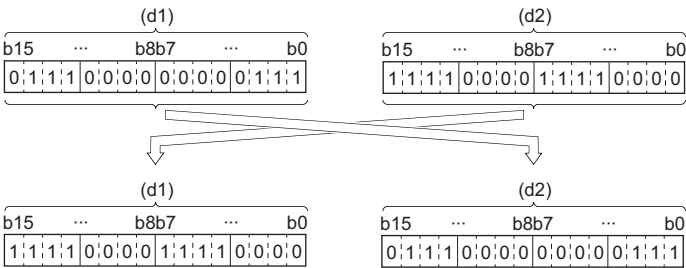
| Operand | Description                                     | Range | Data type            | Data type (label) |
|---------|-------------------------------------------------|-------|----------------------|-------------------|
| (d1)    | Device where the exchange target data is stored | —     | 16-bit signed binary | ANY16             |
| (d2)    | Device where the exchange target data is stored | —     | 16-bit signed binary | ANY16             |
| EN      | Execution condition                             | —     | Bit                  | BOOL              |
| ENO     | Execution result                                | —     | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d1)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (d2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Processing details

These instruction exchange the 16-bit binary data between the devices specified by (d1) and (d2).



### Operation error

There is no operation error.

# Exchanging 32-bit binary data

## DXCH(P)

These instructions exchange the 32-bit binary data specified.

| Ladder | ST                                                    |
|--------|-------------------------------------------------------|
|        | <pre>ENO:=DXCH(EN,d1,d2); ENO:=DXCHP(EN,d1,d2);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DXCH        |                     |
| DXCHP       |                     |

### Setting data

### Description, range, data type

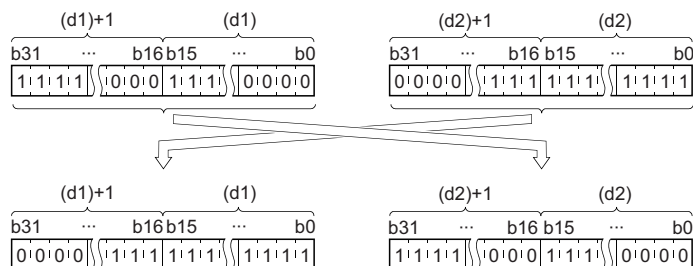
| Operand | Description                                           | Range | Data type            | Data type (label) |
|---------|-------------------------------------------------------|-------|----------------------|-------------------|
| (d1)    | Start device where the exchange target data is stored | —     | 32-bit signed binary | ANY32             |
| (d2)    | Start device where the exchange target data is stored | —     | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                   | —     | Bit                  | BOOL              |
| ENO     | Execution result                                      | —     | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   |             | Double word |      | Indirect specification | Constant |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|-------------|------|------------------------|----------|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |        |
| (d1)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○           | ○    | —                      | —        | —  | — |        |
| (d2)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○           | ○    | —                      | —        | —  | — |        |

### Processing details

These instruction exchange the 32-bit binary data between the device ranges specified by (d1) and (d2).



### Operation error

There is no operation error.

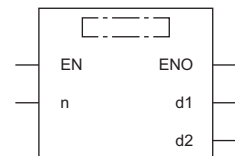
# Exchanging 16-bit binary block data

## BXCH(P)

These instructions exchange the (n) points of 16-bit binary data starting from the devices specified.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | ENO:=BXCH(EN,n,d1,d2);<br>ENO:=BXCHP(EN,n,d1,d2); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BXCH        |                     |
| BXCHP       |                     |

## Setting data

## Description, range, data type

| Operand | Description                                           | Range      | Data type              | Data type (label)   |
|---------|-------------------------------------------------------|------------|------------------------|---------------------|
| (d1)    | Start device where the exchange target data is stored | —          | Word                   | ANY16 <sup>*1</sup> |
| (d2)    | Start device where the exchange target data is stored | —          | Word                   | ANY16 <sup>*1</sup> |
| (n)     | Number of exchange data points                        | 0 to 65535 | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                   | —          | Bit                    | BOOL                |
| ENO     | Execution result                                      | —          | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

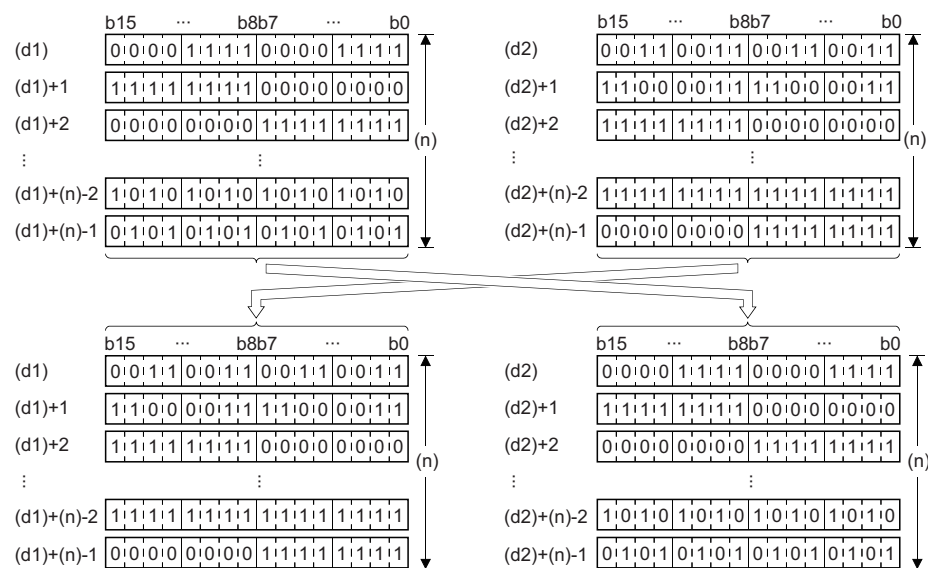
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |



## Processing details

These instructions exchange the (n) points of 16-bit binary data starting from the device specified by (d1) with the (n) points of 16-bit binary data starting from the device specified by (d2).



## Operation error

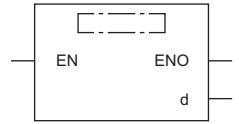
| Error code (SD0) | Description                                                   |
|------------------|---------------------------------------------------------------|
| 2821H            | The device ranges specified by (d1) and (d2) are overlapping. |

# Exchanging the upper and lower bytes of 16-bit binary data

## SWAP(P)

These instructions exchange upper and lower 8-bit data in the specified device.

| Ladder                                                                            | ST                                    |
|-----------------------------------------------------------------------------------|---------------------------------------|
|  | ENO:=SWAP(EN,d);<br>ENO:=SWAPP(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| SWAP        |  |
| SWAPP       |  |

### Setting data

#### Description, range, data type

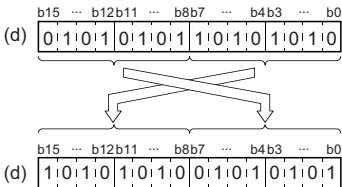
| Operand | Description                                                                     | Range | Data type            | Data type (label) |
|---------|---------------------------------------------------------------------------------|-------|----------------------|-------------------|
| (d)     | Start device for storing the data whose upper and lower 8-bit data is exchanged | —     | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                             | —     | Bit                  | BOOL              |
| ENO     | Execution result                                                                | —     | Bit                  | BOOL              |

#### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Processing details

The device specified by (d) exchanges its upper and lower 8-bit data.



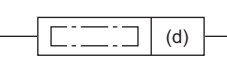
### Operation error

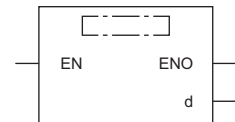
There is no operation error.

# Exchanging the upper and lower bytes of 32-bit binary data

## DSWAP(P)

These instructions exchange upper and lower 8-bit data in the specified device.

| Ladder                                                                            | ST                                              |
|-----------------------------------------------------------------------------------|-------------------------------------------------|
|  | <pre>ENO:=DSWAP(EN,d); ENO:=DSWAPP(EN,d);</pre> |
| FBD/LD                                                                            |                                                 |



### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DSWAP       |  |
| DSWAPP      |  |

### Setting data

### Description, range, data type

| Operand | Description                                                                     | Range | Data type            | Data type (label) |
|---------|---------------------------------------------------------------------------------|-------|----------------------|-------------------|
| (d)     | Start device for storing the data whose upper and lower 8-bit data is exchanged | —     | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                                             | —     | Bit                  | BOOL              |
| ENO     | Execution result                                                                | —     | Bit                  | BOOL              |

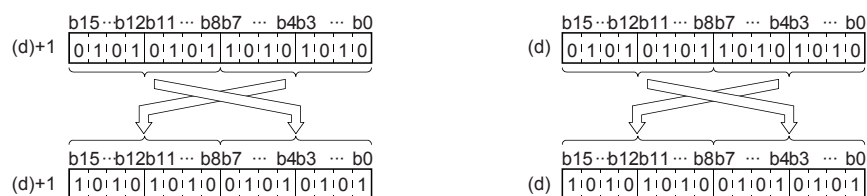
### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   |             | Double word |      | Indirect specification | Constant |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|-------------|------|------------------------|----------|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |        |
| (d)     | ○*1                              | ○   | ○                                     | ○          | ○ | ○           | ○           | ○    | —                      | —        | —  | — |        |

\*1 FX and FY cannot be used.

### Processing details

The device specified by (d) exchanges its upper and lower 8-bit data.



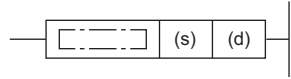
### Operation error

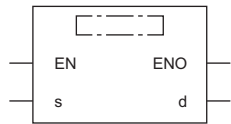
There is no operation error.

# Transferring 1-bit data

## MOVB(P)

These instructions transfer the specified 1-bit data.

| Ladder                                                                            | ST                                        |
|-----------------------------------------------------------------------------------|-------------------------------------------|
|  | ENO:=MOVB(EN,s,d);<br>ENO:=MOVBP(EN,s,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| MOVB        |  |
| MOVBP       |  |

## Setting data

### Description, range, data type

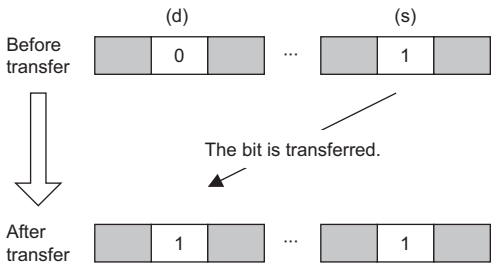
| Operand | Description                                                   | Range | Data type | Data type (label) |
|---------|---------------------------------------------------------------|-------|-----------|-------------------|
| (s)     | Number of the device where the transfer target data is stored | —     | Bit       | ANY_BOOL          |
| (d)     | Transfer destination device number                            | —     | Bit       | ANY_BOOL          |
| EN      | Execution condition                                           | —     | Bit       | BOOL              |
| ENO     | Execution result                                              | —     | Bit       | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |              |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|--------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | —            | — | ○           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | —            | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

These instructions transfer the bit data in the device specified by (s) to the device specified by (d).



## Operation error

There is no operation error.

## Transferring n-bit data

### BLKMOVB(P)

These instructions batch-transfer the (n) points of bit data.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | ENO:=BLKMOVB(EN,s,n,d);<br>ENO:=BLKMOVBP(EN,s,n,d); |
| FBD/LD |                                                     |
|        |                                                     |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BLKMOVB     |                     |
| BLKMOVBP    |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                     | Range      | Data type              | Data type (label)      |
|---------|---------------------------------|------------|------------------------|------------------------|
| (s)     | Transfer source block data      | —          | Bit                    | ANY_BOOL <sup>*1</sup> |
| (d)     | Transfer destination block data | —          | Bit                    | ANY_BOOL <sup>*1</sup> |
| (n)     | Number of transfer data points  | 0 to 65535 | 16-bit unsigned binary | ANY16                  |
| EN      | Execution condition             | —          | Bit                    | BOOL                   |
| ENO     | Execution result                | —          | Bit                    | BOOL                   |

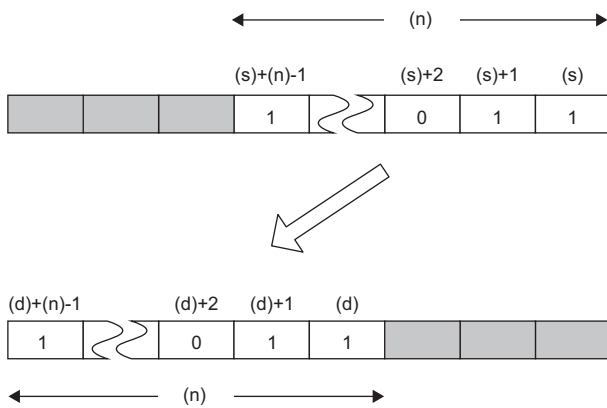
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions batch-transfer the (n) points of bit data starting from the device specified by (s) to the (n) points of bits starting from the device specified by (d).
- Data can be transferred even when the transfer source device and destination device overlap.



## Operation error

There is no operation error.

This part consists of the following chapters.

13 PROGRAM CONTROL

---

14 DATA PROCESSING

---

15 DEBUGGING AND FAILURE DIAGNOSTIC

---

16 STRING PROCESSING

---

17 REAL VALUE PROCESSING

---

18 RANDOM NUMBER

---

19 DEVICE OPERATION

---

20 TIMER, COUNTER

---

21 CLOCK

---

22 MODULE ACCESS

---

23 PID OPERATION INSTRUCTION

---

24 PID CONTROL INSTRUCTIONS

---

25 HIGH-SPEED I/O CONTROL INSTRUCTIONS

---

26 DEDICATED INSTRUCTIONS (POSITIONING FUNCTION)

---

27 HIGH-SPEED COUNTER FUNCTION DEDICATED INSTRUCTIONS

---

28 PULSE RELATED INSTRUCTIONS

---

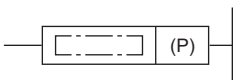
# 13 PROGRAM CONTROL

## 13.1 Program Branch Instructions

### Pointer branch

#### CJ, SCJ, JMP

- CJ: This instruction executes the program specified by the pointer number within the same program file.
- SCJ: This instruction executes the program specified by the pointer number within the same program file starting with the next scan.
- JMP: This instruction unconditionally executes the program specified by the pointer number within the same program file.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

| FBD/LD        |
|---------------|
| Not supported |

#### ■Execution condition

| Instruction | Execution condition                                                                 |
|-------------|-------------------------------------------------------------------------------------|
| CJ<br>SCJ   |  |
| JMP         | Every scan                                                                          |

#### Setting data

#### ■Description, range, data type

| Operand | Description                            | Range | Data type   | Data type (label) |
|---------|----------------------------------------|-------|-------------|-------------------|
| (P)     | Pointer number of the jump destination | —     | Device name | POINTER           |

#### ■Applicable devices

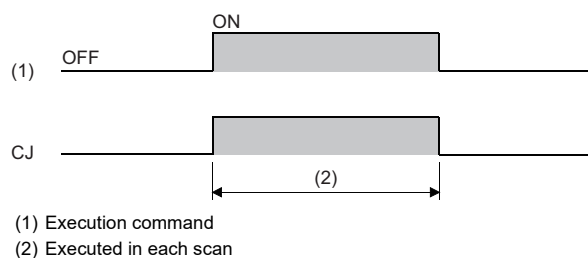
| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (P)     | —                                | —   | —                                     | —           | — | —           | —  | —                      | —        | — | —  | ○          |



## Processing details

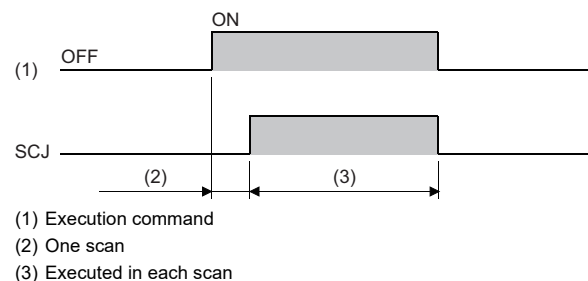
### ■ CJ

- This instruction executes the program specified by the pointer number within the same program file when the execution command is on.
- When the execution command is off, the program in the next step is executed.



### ■ SCJ

- This instruction executes the program specified by the pointer number within the same program file starting with the scan immediately after the execution command turns on.
- When the execution command is off or turned off, the program in the next step is executed.

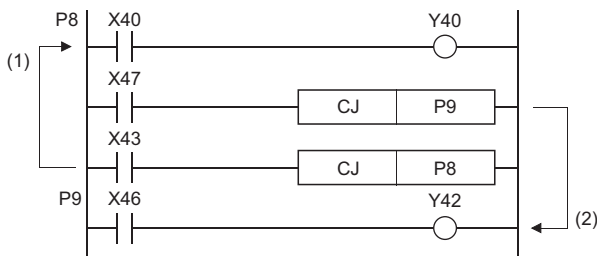


### ■ JMP

This instruction unconditionally executes the program specified by the pointer number within the same program file.

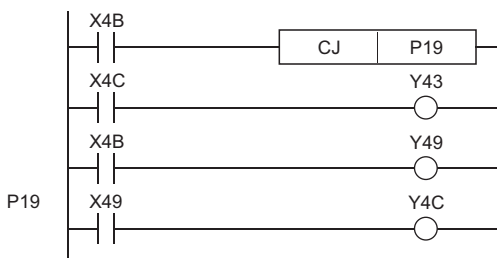
## Precautions

- If the timer with its coil on is skipped by these instructions, time cannot be measured correctly.
- If the OUT instruction is skipped by these instructions, the scan time will be shortened.
- If these instructions specify and jump to the program with a bigger step number, the scan time will be shortened.
- These instructions can specify and jump to the program with a smaller step number. In this case, consider a method to exit a loop so that the watchdog timer does not time out.



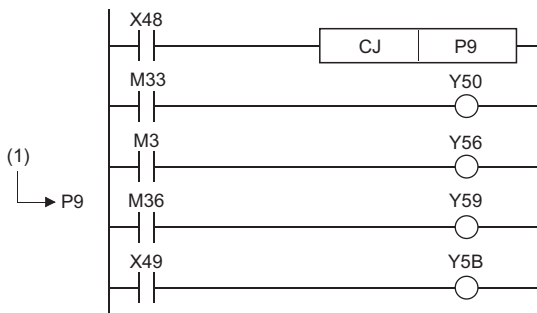
- (1) While X43 is on, the loop is repeated.  
(2) To exit the loop, turn on X47.

- The value in the device skipped with these instructions remains unchanged.



When X4B turns on, the program jumps to the label, P19.  
Y43 and Y49 remain unchanged even if X4B and X4C turn on/off during the execution of the CJ instruction.

- A label (P□) occupies one step.



- (1) A label occupies one step.

- Only the pointer numbers within the same program file can be specified.

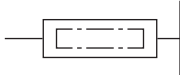
## Operation error

| Error code (SD0) | Description                                                                     |
|------------------|---------------------------------------------------------------------------------|
| 3340H            | The pointer number specified by (P) is not set before the END instruction.      |
|                  | The pointer number specified by (P) is not used as a label in the same program. |
|                  | The pointer number specified by (P) is a global pointer in another program.     |

## Jumping to END

### GOEND

This instruction jumps the program to the FEND or END instruction within the same program file.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

| FBD/LD        |
|---------------|
| Not supported |

### ■ Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| GOEND       |  |

### Processing details

This instruction jumps the program to the FEND or END instruction within the same program file.

### Operation error

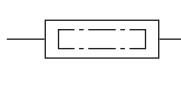
| Error code (SD0) | Description                                                                                                                    |
|------------------|--------------------------------------------------------------------------------------------------------------------------------|
| 3341H            | After execution of the CALL(P) or ECALL(P) instruction, the GOEND instruction is executed before the RET instruction.          |
| 3351H            | The GOEND instruction is executed before the IRET instruction in the interrupt program specified by the interrupt pointer (I). |

# 13.2 Program Execution Control Instructions

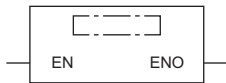
## Disabling/enabling interrupt programs

### DI, EI

- DI: This instruction disables execution of interrupt programs.
- EI: This instruction clears the interrupt disabled state.

| Ladder                                                                            | ST                           |
|-----------------------------------------------------------------------------------|------------------------------|
|  | ENO:=DI(EN);<br>ENO:=EI(EN); |

### FBD/LD



### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DI<br>EI    |  |

### Processing details

#### DI

- This instruction disables execution of interrupt programs until the EI instruction is executed even though they are requested.
- For the operation of the DI (Disabling interrupt programs) instruction used with the DI (Disabling interrupt programs with specified priority or lower) instruction, refer to the following.

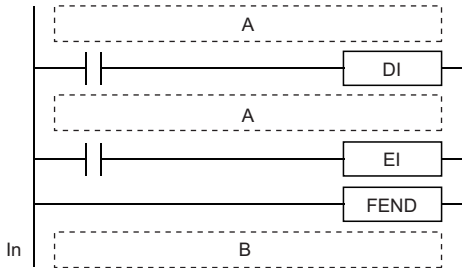
📖 Page 542 DI

- The DI (Disabling interrupt programs) instruction cannot be executed in interrupt programs. If executed, no processing is performed.

## ■EI

- This instruction clears the interrupt disabled state that has been set by the DI (Disabling interrupt programs) instruction, and enables execution of interrupt programs with the interrupt pointer numbers permitted by the IMASK instruction. When the IMASK instruction is not executed, I32 to I43 are disabled.
- When the system is powered on or the controller is reset and moved to RUN, the system is in the state where the EI instruction has been executed. When the initial execution type program is set, the system is in the state where the DI instruction has been executed during the execution of the initial execution type program in the first scan after RUN, and where the EI instruction has been executed from the execution of the program in the second scan after RUN.
- For the operation of the EI instruction used with the DI (Disabling interrupt programs with specified priority or lower) instruction, refer to the following.

➡ Page 542 DI



A: Sequence program  
B: Interrupt program

Even if an interrupt factor occurs between the DI and EI instructions, the corresponding interrupt program will not be executed until the processing between the DI and EI instructions completes.

- The operation of the EI instruction in interrupt programs differs depending on the execution status of the DI (Disabling interrupt programs with specified priority or lower) instruction before the EI instruction. The EI instruction in the interrupt program after the execution of the DI (Disabling interrupt programs with specified priority or lower) instruction can be executed. The following table shows whether the EI instruction can be executed in the interrupt program.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>When the EI instruction is executed in the interrupt program after the DI (Disabling interrupt programs with specified priority or lower) instruction was executed in the main routine program</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p><b>When the EI instruction is executed in the interrupt program without executing the DI (Disabling interrupt programs with specified priority or lower) instruction in the main routine program</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <p>The diagram illustrates the execution of the EI instruction in the interrupt program after the DI instruction has been executed in the main routine program. It consists of two parts: A (Main routine program) and B (Interrupt program). In part A, a normally closed contact labeled SM400 is connected to a coil labeled INC D10. Below this, a dashed box contains a coil labeled DI K7, with an arrow pointing to it labeled (1). A curved arrow labeled (2) points from the DI K7 coil to part B. In part B, a normally open contact labeled M0 is connected to a coil labeled Y40. Below this, a dashed box contains a coil labeled EI, with an arrow pointing to it labeled (3).</p> | <p>The diagram illustrates the execution of the EI instruction in the interrupt program without the DI instruction being executed in the main routine program. It consists of two parts: A (Main routine program) and B (Interrupt program). In part A, a normally closed contact labeled SM400 is connected to a coil labeled INC D10. Below this, a dashed box is present, with an arrow pointing to it labeled (1). A curved arrow labeled (2) points from this dashed box to part B. In part B, a normally open contact labeled M0 is connected to a coil labeled Y40. Below this, a dashed box contains a coil labeled EI, with an arrow pointing to it labeled (3).</p> |
| <p>A: Main routine program<br/>B: Interrupt program</p> <p>(1) The DI (Disabling interrupt programs with specified priority or lower) instruction is executed.</p> <p>(2) An interrupt has occurred.</p> <p>(3) The execution is enabled.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>A: Main routine program<br/>B: Interrupt program</p> <p>(1) The DI (Disabling interrupt programs with specified priority or lower) instruction is not executed.</p> <p>(2) An interrupt has occurred.</p> <p>(3) The execution is disabled. (No processing is performed.)</p>                                                                                                                                                                                                                                                                                                                                                                                              |

- EI and DI instructions in the initial execution type program can be executed. However, if the EI and DI instructions are executed in the initial execution type program, the specified priority setting is valid until the second scan is started. The system is in the state where the EI instruction has been executed from the time when the second scan of the program is executed.

### Point

If the interrupt disabled section is set exceeding the execution cycle of the network communication cycle synchronization interrupt, a cycle over may occur.

Either create a program by minimizing the interrupt disabled section, or exclude network communication cycle synchronization interrupts by using the DI (Disabling interrupt programs with specified priority or lower) instruction. If the DI instruction is used, interference with network communication cycle synchronization interrupts occurs, causing malfunction in the following functions.

- Motion function
- Network cycle communication function

| Error code (SD0) | Description                                                                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3332H            | More than 16 DI (Disabling interrupt programs) instructions and DI (Disabling interrupt programs with specified priority or lower) instructions are nested. |

If the interrupt disabled section for the DI instruction is too long, the following errors or events may occur.

If an error or event occurs, either create a program by minimizing the interrupt disabled section, or exclude network communication cycle synchronization interrupts from prohibition by using the DI (Disabling interrupt programs with specified priority or lower) instruction.

| Error code/ event code | Description                                                                                                                                                                                                                                     |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 00F08                  | Operation processing or other fixed scan processing is not completed within the set cycle.                                                                                                                                                      |
| 11F0 <sup>*1</sup>     | The execution interval of a synchronous interrupt program has exceeded the set value.<br>The network communication cycle synchronous program has not been completed within the set communication cycle interval of the CC-Link IE TSN function. |
| 11F1 <sup>*1</sup>     | The execution interval of a synchronous interrupt program has exceeded the set value.<br>A cycle where the network communication cycle synchronous program was not executed has been detected.                                                  |
| 1860                   | Cyclic transmission skip occurred.                                                                                                                                                                                                              |
| 1A00                   | Operation processing or other fixed scan processing is not completed within the set cycle.                                                                                                                                                      |
| 2600                   | Cyclic processing has not been completed by the start timing for the next network communication cycle.                                                                                                                                          |
| 3402                   | Operation processing or other fixed scan processing is not completed within the set cycle.                                                                                                                                                      |
| 3AF0                   | Cyclic processing performed in a medium speed cycle cannot be completed by the start timing of the next network communication cycle.                                                                                                            |
| 3AF1                   | Cyclic processing performed in a low speed cycle cannot be completed by the start timing of the next network communication cycle.                                                                                                               |

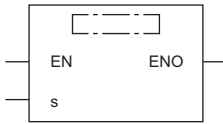
\*1 This occurs when the CPU parameter "Execution Interval Excess (Network Communication Period Synchronization)" is set to "Detect".

# Disabling interrupt programs with specified priority or lower

## DI

This instruction disables execution of interrupt programs with the specified priority or lower.

| Ladder                                                                            | ST               |
|-----------------------------------------------------------------------------------|------------------|
|  | ENO:=DI_1(EN,s); |

| FBD/LD                                                                                                        |
|---------------------------------------------------------------------------------------------------------------|
| <br>(□ is replaced by DI_1.) |

### ■Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DI          |  |

### Setting data

### ■Description, range, data type

| Operand | Description                | Range   | Data type              | Data type (label) |
|---------|----------------------------|---------|------------------------|-------------------|
| (s)     | Interrupt disable priority | 1 to 32 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition        | —       | Bit                    | BOOL              |
| ENO     | Execution result           | —       | Bit                    | BOOL              |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | —    | ○                                     | —           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

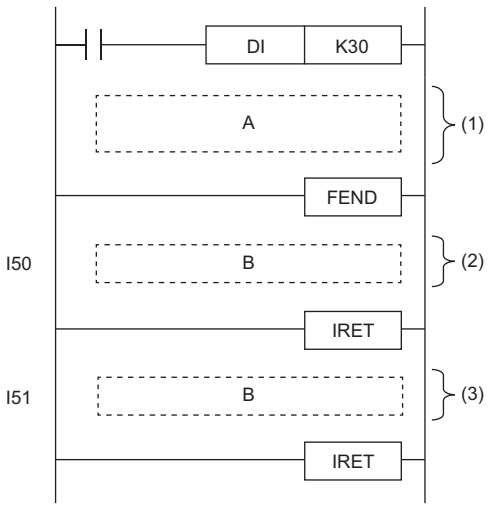


## Processing details

- This instruction disables execution of interrupt programs with the interrupt pointer numbers specified by (s) or lower.

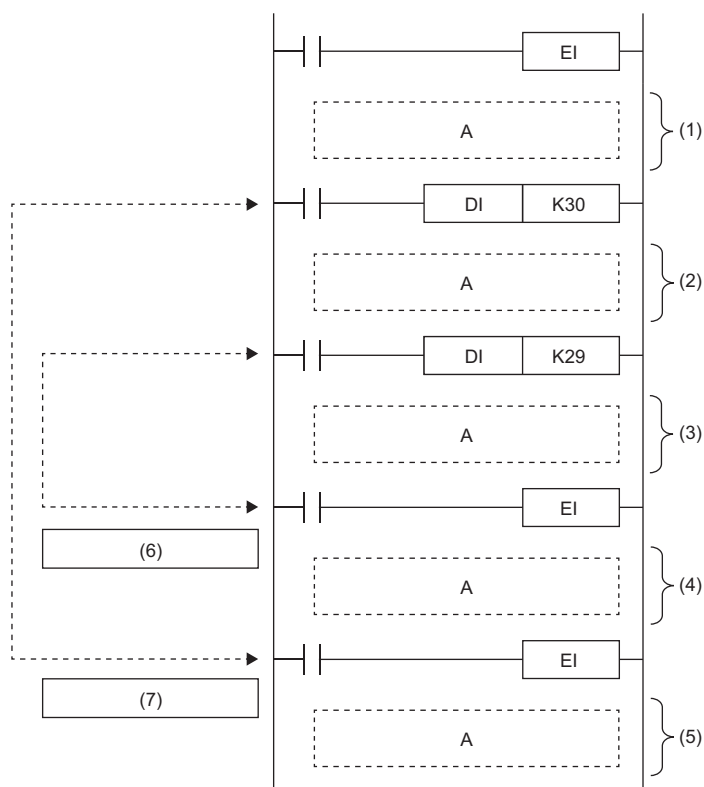
### Interrupt priority setting

| I No. | Priority |
|-------|----------|
| I50   | 29       |
| I51   | 30       |



- A: Sequence program  
B: Interrupt program  
(1) Interrupt disabled section for priority 30 or less (Interrupt enabled section for priority 29 or above)  
(2) The interrupt program can be executed because its priority is 29.  
(3) The interrupt program cannot be executed because its priority is 30.

- The execution of the EI instruction enables the interrupt that has been disabled by a single DI (Disabling interrupt programs with specified priority or lower) instruction. Note that if interrupts have been disabled only by the DI (Disabling interrupt programs) instruction, executing the EI instruction only once enables interrupts in all priorities.

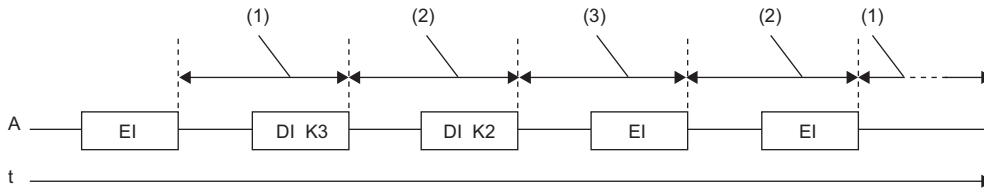


A: Sequence program

- (1) Interrupt enabled section for all priorities
- (2) Interrupt disabled section for priority 30 or less (Interrupt enabled section for priority 29 or above)
- (3) Interrupt disabled section for priority 29 or less (Interrupt enabled section for priority 28 or above)
- (4) Interrupt disabled section for priority 30 or less (Interrupt enabled section for priority 29 or above)
- (5) Interrupt enabled section for all priorities
- (6) EI instruction for [DI K29]
- (7) EI instruction for [DI K30]

- When multiple DI (Disabling interrupt programs with specified priority or lower) instructions are executed and the specified interrupt disable priority is lower than the priority of the currently disabled interrupt, the priority of the currently disabled interrupt remains unchanged.
- Up to 16 DI instructions can be nested.
- The priority of the interrupt pointer can be set by parameters. (User's manual for the controller used)
- The interrupt disabled priority currently set can be checked in SD758.
- If the DI (Disabling interrupt programs with specified priority or lower) instruction is executed in the interrupt program and the interrupt disabled priority is changed, the value in SD758 also changes.

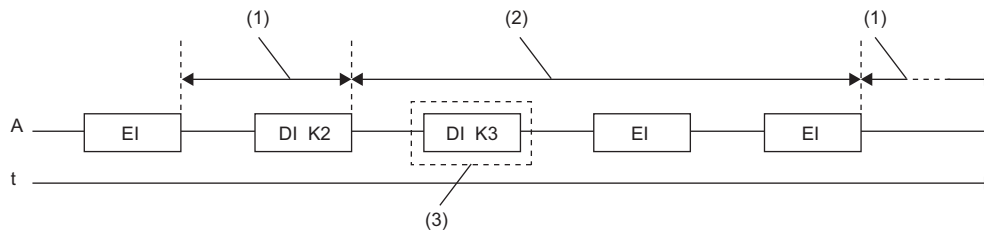
- When the DI (Disabling interrupt programs) instruction, DI (Disabling interrupt programs with specified priority or lower) instruction, and EI instruction are executed, the interrupt disabled sections will be as follows.
- When another DI (Disabling interrupt programs with specified priority or lower) instruction with a wider priority range is executed during execution of the DI (Disabling interrupt programs with specified priority or lower) instruction



A: Scan execution type program

- (1) Interrupt enabled section for all priorities
- (2) Interrupt disabled section for priority 3 or less (Interrupt enabled section for priority 2 or above)
- (3) Interrupt disabled section for priority 2 or less (Interrupt enabled section for priority 1 or above)

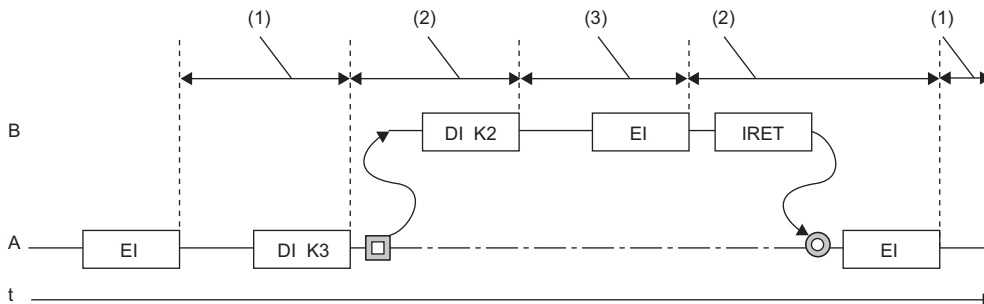
- When another DI (Disabling interrupt programs with specified priority or lower) instruction with a narrower priority range is executed during execution of the DI (Disabling interrupt programs with specified priority or lower) instruction



A: Scan execution type program

- (1) Interrupt enabled section for all priorities
- (2) Interrupt disabled section for priority 2 or less (Interrupt enabled section for priority 1 or above)
- (3) The priority of the disabled interrupt remains unchanged because the interrupt with priority 2 or lower is already disabled.

- When the DI (Disabling interrupt programs with specified priority or lower) instruction is executed in the interrupt program

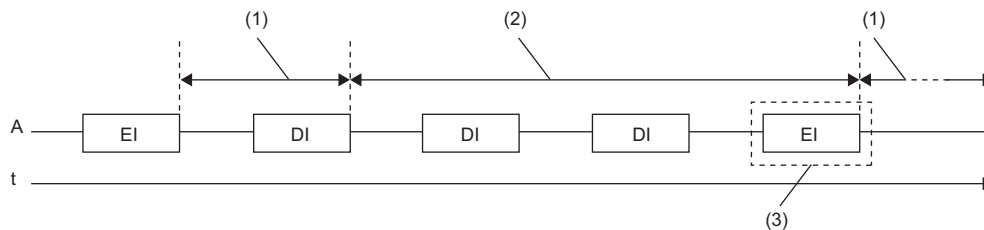


A: Scan execution type program

B: Interrupt program

- (1) Interrupt enabled section for all priorities
- (2) Interrupt disabled section for priority 3 or less (Interrupt enabled section for priority 2 or above)
- (3) Interrupt disabled section for priority 2 or less (Interrupt enabled section for priority 1 or above)

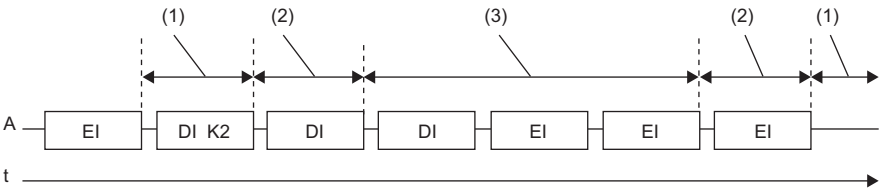
- When only the DI (Disabling interrupt programs) instruction is executed



A: Scan execution type program

- (1) Interrupt enabled section for all priorities
- (2) Interrupt disabled section for priority 1 or less (Interrupt disabled section for all priorities)
- (3) Executing the EI instruction only once enables interrupts with all priorities.

- When the DI (Disabling interrupt programs with specified priority or lower) instruction and the DI (Disabling interrupt programs) instruction are executed in this order



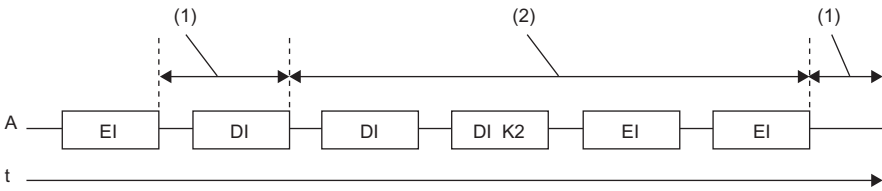
A: Scan execution type program

(1) Interrupt enabled section for all priorities

(2) Interrupt disabled section for priority 2 or less (Interrupt enabled section for priority 1 or above)

(3) Interrupt disabled section for priority 1 or less (Interrupt disabled section for all priorities)

- When the DI (Disabling interrupt programs) instruction and the DI (Disabling interrupt programs with specified priority or lower) instruction are executed in this order



A: Scan execution type program

(1) Interrupt enabled section for all priorities

(2) Interrupt disabled section for priority 1 or less (Interrupt disabled section for all priorities)

- The DI instruction in the initial execution type program can be executed. However, if the DI instruction is executed in the initial execution type program, the specified priority setting is valid until the second scan is started. The system is in the state where the EI instruction has been executed from the time when the second scan of the program is executed.

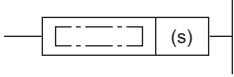
## Operation error

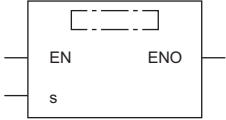
| Error code (SD0) | Description                                                                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | The priority specified by (s) is out of range.                                                                                                              |
| 3332H            | More than 16 DI (Disabling interrupt programs) instructions and DI (Disabling interrupt programs with specified priority or lower) instructions are nested. |

# Interrupt program mask

## IMASK

This instruction enables or disables the execution of the interrupt program with the specified interrupt pointer number.

| Ladder                                                                            | ST                |
|-----------------------------------------------------------------------------------|-------------------|
|  | ENO:=IMASK(EN,s); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| IMASK       | Every scan          |

### Setting data

### ■Description, range, data type

| Operand | Description                                                                     | Range | Data type            | Data type (label)                       |
|---------|---------------------------------------------------------------------------------|-------|----------------------|-----------------------------------------|
| (s)     | Interrupt mask data or the start device where the interrupt mask data is stored | —     | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 16) |
| EN      | Execution condition                                                             | —     | Bit                  | BOOL                                    |
| ENO     | Execution result                                                                | —     | Bit                  | BOOL                                    |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- This instruction enables or disables the execution of the interrupt program with the interrupt pointer number specified by the 16 points of bit pattern starting from the device specified by (s).
  - 1 (on): Enables the execution of the interrupt program.
  - 0 (off): Disables the execution of the interrupt program.
- The interrupt pointer numbers correspond to individual bits as shown below.

|        | b15  | b14  | b13  | b12  | b11  | b10  | b9   | b8   | b7   | b6   | b5   | b4   | b3   | b2   | b1   | b0   |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| (s)    | I15  | I14  | I13  | I12  | I11  | I10  | I9   | I8   | I7   | I6   | I5   | I4   | I3   | I2   | I1   | I0   |
| (s)+1  | I31  | I30  | I29  | I28  | I27  | I26  | I25  | I24  | I23  | I22  | I21  | I20  | I19  | I18  | I17  | I16  |
| (s)+2  | I47  | I46  | I45  | I44  | I43  | I42  | I41  | I40  | I39  | I38  | I37  | I36  | I35  | I34  | I33  | I32  |
| (s)+3  | I63  | I62  | I61  | I60  | I59  | I58  | I57  | I56  | I55  | I54  | I53  | I52  | I51  | I50  | I49  | I48  |
| (s)+4  | I79  | I78  | I77  | I76  | I75  | I74  | I73  | I72  | I71  | I70  | I69  | I68  | I67  | I66  | I65  | I64  |
| (s)+5  | I95  | I94  | I93  | I92  | I91  | I90  | I89  | I88  | I87  | I86  | I85  | I84  | I83  | I82  | I81  | I80  |
| (s)+6  | I111 | I110 | I109 | I108 | I107 | I106 | I105 | I104 | I103 | I102 | I101 | I100 | I99  | I98  | I97  | I96  |
| (s)+7  | I127 | I126 | I125 | I124 | I123 | I122 | I121 | I120 | I119 | I118 | I117 | I116 | I115 | I114 | I113 | I112 |
| (s)+8  | I143 | I142 | I141 | I140 | I139 | I138 | I137 | I136 | I135 | I134 | I133 | I132 | I131 | I130 | I129 | I128 |
| (s)+9  | I159 | I158 | I157 | I156 | I155 | I154 | I153 | I152 | I151 | I150 | I149 | I148 | I147 | I146 | I145 | I144 |
| (s)+10 | I175 | I174 | I173 | I172 | I171 | I170 | I169 | I168 | I167 | I166 | I165 | I164 | I163 | I162 | I161 | I160 |
| (s)+11 | I191 | I190 | I189 | I188 | I187 | I186 | I185 | I184 | I183 | I182 | I181 | I180 | I179 | I178 | I177 | I176 |
| (s)+12 | I207 | I206 | I205 | I204 | I203 | I202 | I201 | I200 | I199 | I198 | I197 | I196 | I195 | I194 | I193 | I192 |
| (s)+13 | I223 | I222 | I221 | I220 | I219 | I218 | I217 | I216 | I215 | I214 | I213 | I212 | I211 | I210 | I209 | I208 |
| (s)+14 | I239 | I238 | I237 | I236 | I235 | I234 | I233 | I232 | I231 | I230 | I229 | I228 | I227 | I226 | I225 | I224 |
| (s)+15 | I255 | I254 | I253 | I252 | I251 | I250 | I249 | I248 | I247 | I246 | I245 | I244 | I243 | I242 | I241 | I240 |

- When the system is powered on or the controller is reset, the execution of interrupt programs I0 to I31 and I44 to I255 is enabled, and the execution of interrupt programs I32 to I43 is disabled.
- The states of the device range (s) to (s)+15 are stored in SD1400 to SD1415 (IMASK instruction mask pattern).

### Point

The IMASK instruction can enable or disable the execution of interrupt pointers I0 to I255 altogether. To enable or disable the execution of interrupt pointers I0 to I255, substitute the SIMASK instruction for the IMASK instruction in the program.

For details on the SIMASK instruction, refer to the following.

📖 Page 549 SIMASK

## Operation error

There is no operation error.

## Disabling/enabling the specified interrupt pointer

### SIMASK

This instruction enables or disables the execution of the interrupt program with the specified interrupt pointer number.

| Ladder | ST                   |
|--------|----------------------|
|        | ENO:=SIMASK(EN,I,s); |
| FBD/LD |                      |
|        |                      |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SIMASK      |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                                   | Range                     | Data type              | Data type (label) |
|---------|---------------------------------------------------------------|---------------------------|------------------------|-------------------|
| (I)     | Interrupt pointer number to be interrupt-enabled or -disabled | I0 to I255                | Device name            | POINTER*1         |
| (s)     | Execution status of the specified interrupt pointer           | 0: Disabled<br>1: Enabled | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition                                           | —                         | Bit                    | BOOL              |
| ENO     | Execution result                                              | —                         | Bit                    | BOOL              |

\*1 Only labels assigned to the device (I) can be used.

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             | Double word |             | Indirect specification | Constant |   |    | Others (I) |
|---------|----------------------------------|------|---------------------------------------|-------------|-------------|-------------|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |            |
| (I)     | —                                | —    | —                                     | —           | —           | —           | —                      | —        | — | —  | ○          |
| (s)     | —                                | —    | ○                                     | —           | ○           | —           | —                      | ○        | — | —  | —          |

### Processing details

- This instruction, according to the data specified by (s), enables or disables the execution of the interrupt program with the interrupt pointer number specified by (I).
- When (s) is 1: The execution of the interrupt program is enabled.
- When (s) is 0: The execution of the interrupt program is disabled.
- When the system is powered on or the controller is reset, the execution of interrupt programs I0 to I31 and I44 to I255 is enabled, and the execution of interrupt programs I32 to I43 is disabled.
- The execution status of the interrupt pointers is stored in SD1400 to SD1415 (IMASK instruction mask pattern).



The device (I) can be index modified. Using the SIMASK instruction specifying the index-modified device can enable or disable the execution of interrupt pointers I0 to I255.

## Operation error

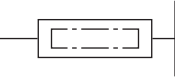
| Error code<br>(SD0) | Description                                                                       |
|---------------------|-----------------------------------------------------------------------------------|
| 3285H               | The interrupt pointer number specified by (I) is out of the valid range.          |
|                     | The value in the device specified by (s) is neither 0 (disabled) nor 1 (enabled). |



## Returning from the interrupt program

### IRET

This instruction indicates the end of the processing of an interrupt program.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

| FBD/LD        |
|---------------|
| Not supported |

### ■ Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| IRET        | Every scan          |

### Processing details

- This instruction indicates the end of the processing of the interrupt program specified by the interrupt pointer (I).
- The instruction returns control to the sequence program after execution.

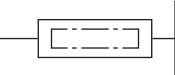
### Operation error

| Error code (SD0) | Description                                                                                                   |
|------------------|---------------------------------------------------------------------------------------------------------------|
| 3350H            | There is no pointer corresponding to the interrupt number.                                                    |
| 3351H            | After an interrupt occurs, the END, FEND, GOEND, or STOP instruction is executed before the IRET instruction. |
| 3352H            | The IRET instruction is executed before the FEND instruction in the main program.                             |
| 3353H            | The IRET instruction is executed in a fixed scan execution type program.                                      |
| 3354H            | The IRET instruction is executed in an event execution type program.                                          |

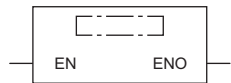
# Resetting the watchdog timer

## WDT(P)

These instructions reset the watchdog timer.

| Ladder                                                                            | ST                              |
|-----------------------------------------------------------------------------------|---------------------------------|
|  | ENO:=WDT(EN);<br>ENO:=WDTP(EN); |

## FBD/LD

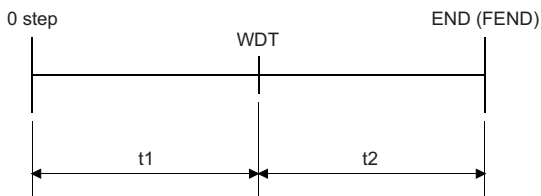


### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| WDT         |  |
| WDTP        |  |

### Processing details

- These instructions reset the watchdog timer in a program.
- These instructions are used when the scan time exceeds the value set for the watchdog timer depending on the condition. If the scan time exceeds the value set for the watchdog timer every scan, change the watchdog timer value in parameter using the engineering tool.
- The time values required for t1 from step 0 to the WDT(P) instruction and t2 from the WDT(P) instruction to the END(FEND) instruction must not exceed the value set for the watchdog timer.



- The instruction can be used twice or more in a single scan, but it takes time to turn off the output when an error occurs.
- Executing the instruction does not clear the scan time value stored in the special register. For this reason, the scan time value in the special register may be greater than the value set for the watchdog timer in parameter.

### Operation error

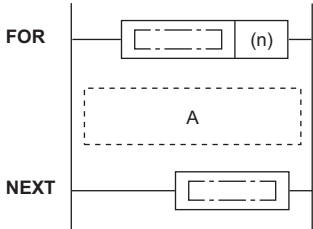
There is no operation error.

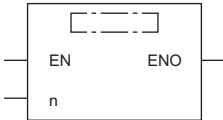
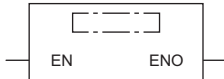
## 13.3 Structure Creation Instructions

### Performing the FOR to NEXT instruction loop

#### FOR, NEXT

These instructions execute the processing between the FOR instruction and the NEXT instruction (n) times.

| Ladder                                                                                                     | ST            |
|------------------------------------------------------------------------------------------------------------|---------------|
|  <p>A: Repeat program</p> | Not supported |

| FBD/LD                                                                                         |                                                                                                  |
|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| <p>[FOR]</p>  | <p>[NEXT]</p>  |

#### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| FOR<br>NEXT | Every scan          |

#### Setting data

#### ■Description, range, data type

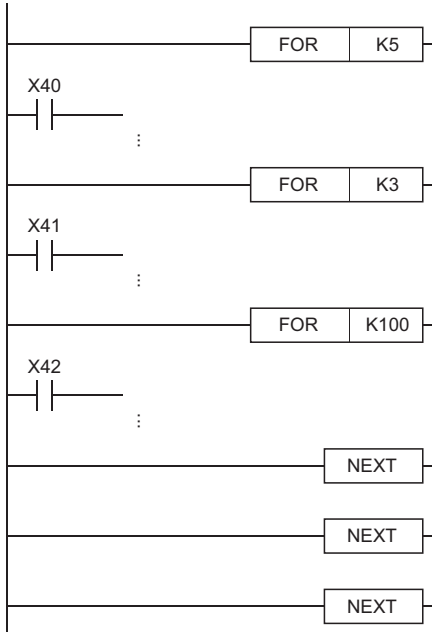
| Operand | Description                             | Range      | Data type            | Data type (label) |
|---------|-----------------------------------------|------------|----------------------|-------------------|
| (n)     | Number of FOR to NEXT instruction loops | 1 to 32767 | 16-bit signed binary | ANY16             |
| EN      | Execution condition                     | —          | Bit                  | BOOL              |
| ENO     | Execution result                        | —          | Bit                  | BOOL              |

#### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             | Z | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | — | —      |

## Processing details

- After the FOR to NEXT instruction loop is executed unconditionally (n) times, the step following the NEXT instruction is executed.
- Specify a value 1 to 32767 for (n). If a value -32768 to 0 is specified, the processing is performed regarding (n) as 1.
- To not to execute the FOR to NEXT instruction loop, use the CJ or SCJ instruction to jump the instruction loop.
- Up to 16 FOR instructions can be nested.

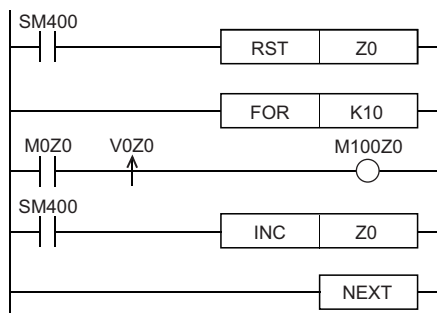


## Precautions

- To terminate the FOR to NEXT instruction loop being executed, use the BREAK instruction.

☞ Page 556 BREAK(P)

- To perform pulse operations of an index-modified program within the FOR to NEXT instruction loop, use the EGP or EGF instruction. Note, however, that no rising edge or falling edge instruction can be used on the operation output side.



- The JMP instruction cannot be used to branch from outside the FOR to NEXT instruction loop to inside the FOR to NEXT instruction loop, and from inside the FOR to NEXT instruction loop to outside the FOR to NEXT instruction loop, resulting in a conversion error.
- If the pointer device/label specified by the JMP instruction inside the FOR to NEXT instruction loop is index-modified, the branch cannot be executed, resulting in a conversion error.
- The CALL(P) instruction cannot be used to branch from outside the FOR to NEXT instruction loop to inside the FOR to NEXT instruction loop, resulting in a conversion error. However, if the pointer device/label specified as the branch destination in the CALL(P) instruction is index-modified and a pointer that exists in FOR to NEXT is specified after the index modification is resolved, an error (error code: 3340H) occurs when the CALL(P) instruction is executed. For details on the CALL(P) instruction, refer to the following.

☞ Page 558 CALL(P)

- For a nested structure within FOR to NEXT instruction loop, the pointer device/label specified by the JMP and other instructions can be described only if it is in the same hierarchy as the JMP and other instructions, which is the execution origin. Describing in a different hierarchy results in a convention error.

## Operation error

There is no operation error.

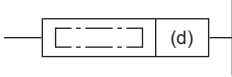
### Point

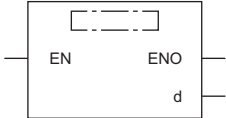
To create an easy-to-understand program, use a pair of instructions, the FOR and NEXT instructions, within a single program block.

# Forcibly terminating the FOR to NEXT instruction loop

## BREAK(P)

These instructions forcibly terminate the loop processing between the FOR and NEXT instructions, and pass the control to the processing of FOR to NEXT instruction or later.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| BREAK       |  |
| BREAKP      |  |

## Setting data

## Description, range, data type

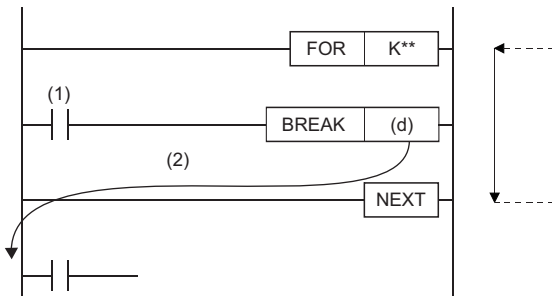
| Operand | Description                                                    | Range | Data type            | Data type (label) |
|---------|----------------------------------------------------------------|-------|----------------------|-------------------|
| (d)     | Number of the device for storing the remaining number of loops | —     | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                            | —     | Bit                  | BOOL              |
| ENO     | Execution result                                               | —     | Bit                  | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             | Z | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions forcibly terminate the loop processing between the FOR and NEXT instructions, and pass the control to the processing of FOR to NEXT instruction or later.



If no BREAK instruction is executed, the program performs loop processing as many times as specified by the FOR instruction.

- (1) Forced termination condition  
(2) When the condition is met

- The remaining number of FOR to NEXT instruction loops at the time of forced termination is stored in (d). The remaining number of loops includes the processing when the BREAK(P) instruction is executed.
- The BREAK(P) instruction can be used only within the FOR to NEXT instruction loop.
- The BREAK(P) instruction is valid only for one level of nesting. To forcibly terminate multiple levels of nesting, execute as many BREAK(P) instructions as nesting levels.

### Point

When applying a program from a different series, immediately after the NEXT instruction ends, write the process to be performed when the forced termination condition written to the branch destination pointer is met.

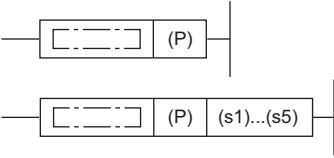
## Operation error

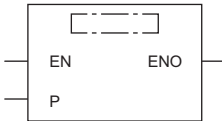
There is no operation error.

# Calling a subroutine program

## CALL(P)

These instructions execute the subroutine program of the specified pointer.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| CALL        |  |
| CALLP       |  |

## Setting data

## Description, range, data type

| Operand        | Description                                                         | Range                     | Data type                                     | Data type (label) |
|----------------|---------------------------------------------------------------------|---------------------------|-----------------------------------------------|-------------------|
| (P)            | Start pointer number of subroutine program                          | —                         | Device name                                   | POINTER           |
| (s1) to (s5)*1 | Device number to be passed to the subroutine program as an argument | -2147483648 to 2147483647 | Bit/16-bit signed binary/32-bit signed binary | ANY               |
| EN             | Execution condition                                                 | —                         | Bit                                           | BOOL              |
| ENO            | Execution result                                                    | —                         | Bit                                           | BOOL              |

\*1 Cannot be specified in FBD/LD.

## Applicable devices

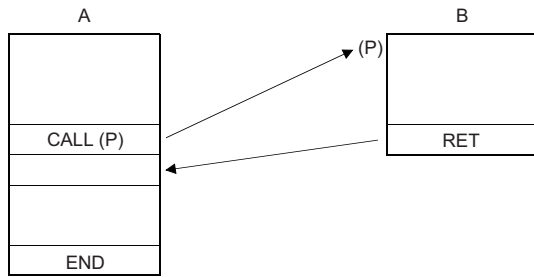
| Operand      | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|--------------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|              | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (P)          | —                                | —   | —                                     | —           | — | —           | —  | —                      | —        | — | —  | ○          |
| (s1) to (s5) | ○*1                              | ○   | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |

\*1 Devices other than F can be used.



## Processing details

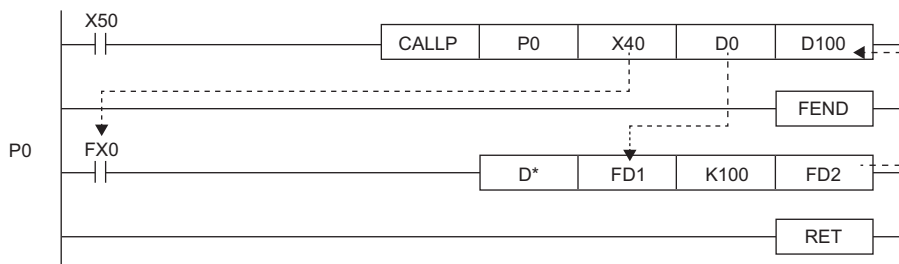
- These instructions execute the subroutine program of the pointer specified by (P). The instructions can execute the subroutine program specified by a pointer in the same program file or the subroutine program specified by a global pointer.



A: Main routine program

B: Subroutine program

- When the function device (FX, FY, or FD) is used in the subroutine program, specify the device corresponding to the function device in (s1) to (s5). The following figure shows the data of the device areas specified by (s1) to (s5).



- Before execution of the subroutine program, bit data is transferred to FX and word data is transferred to FD.
- After execution of the subroutine program, the data in FY and FD are transferred to the corresponding devices.
- The data transfer size for FX, FY, and FD differs depending on the data type specified in (s1) to (s5).

### ■When a device is specified

Function devices FX and FY are transferred in units of bits. Function device FD is transferred in units of 4 words. The size of data to be processed varies depending on the type of the device specified by an argument.

The device specified as a function device should be secured for the data size. An error occurs if an appropriate data area cannot be secured.

The following table lists the data sizes of each function device.

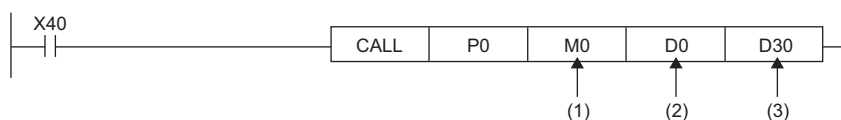
| Function device | Device to be used                        | Sizes of data when transferred to function devices from (s1) to (s5) | Sizes of data when transferred from function devices to (s1) to (s5) |
|-----------------|------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| FX, FY          | Bit device                               | 1 bit                                                                | 1 bit                                                                |
|                 | Bit-specified word device                | 1 bit                                                                | 1 bit                                                                |
| FD              | Digit-specified bit device <sup>*1</sup> | 4 words                                                              | Digit-specified size or 4 words <sup>*2</sup>                        |
|                 | Word device                              | 4 words                                                              | 4 words                                                              |

<sup>\*1</sup> It can be specified even if the device number specified by (s1) to (s5) is not a multiple of 16 in bit device digit specification mode.

<sup>\*2</sup> If the device number is a multiple of 16 and the digit specification is K4 or K8, size of 4 words will be transferred.

#### Ex.

The following operation occurs when a device is specified.



(1) M0 is transferred to FX0.

(2) D0 to D3 are transferred to FD1.

(3) D30 to D33 are transferred to FD2.

## ■When a label is specified

When data is transferred to function devices from (s1) to (s5), function devices FX and FY are transferred in units of bits.

Function device FD is transferred in units of 4 words.

When data is transferred from function devices to (s1) to (s5), function devices FX and FY are transferred in units of bits. The unit of transfer for function device FD is the label-assigned size unit.

The following table lists the data sizes of each function device.

| Function device | Label-assigned size | Sizes of data when transferred to function devices from (s1) to (s5) | Sizes of data when transferred from function devices to (s1) to (s5) |
|-----------------|---------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| FX, FY          | 1 bit               | 1 bit                                                                | 1 bit                                                                |
| FD              | 2 bits or more      | 4 words* <sup>1</sup>                                                | Label-assigned size* <sup>2</sup>                                    |

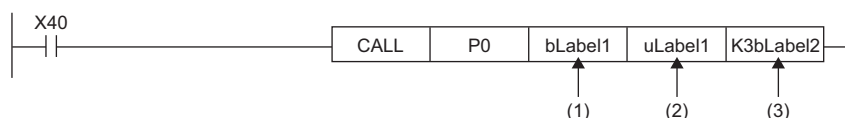
\*<sup>1</sup> If the assigned size of the specified label/structure is less than 4 words, 0 is transferred for the area that is less than 4 words.

\*<sup>2</sup> If the assigned size of the specified label/structure is 4 words or more, 4 words are transferred.

### Ex.

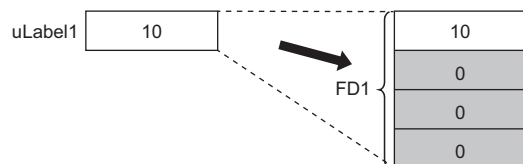
The following table lists the label names and label types when data is transferred to function devices from (s1) to (s5).

| Label name | Label type           |
|------------|----------------------|
| bLabel1    | Bit type label       |
| uLabel1    | Word type label      |
| K3bLabel2  | Array bit type label |

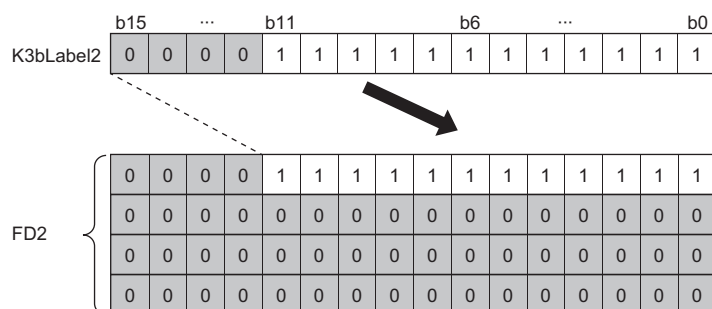


(1) bLabel1 (1 bit) is transferred to FX0.

(2) uLabel1 (1 word) is transferred to FD1. Since the assigned size is less than 4 words, 0 is transferred for the area that is less than 4 words.



(3) 1 word of K3bLabel2 is transferred to FD2. Since the assigned size is less than 4 words, 0 is transferred for the area that is less than 4 words.

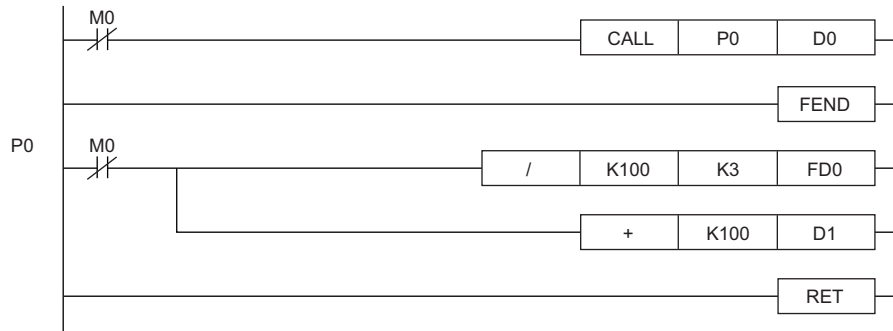
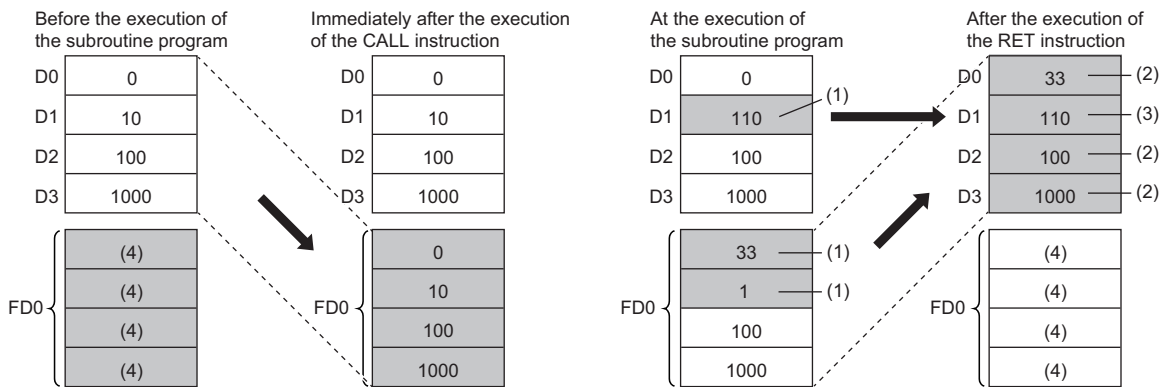


- The CALL(P) instruction can use (s1) to (s5).
- The number of function devices used in the subroutine program must be identical to the number of arguments of the CALL(P) instruction. Also, the types of function devices and CALL(P) instruction arguments must be the same.
- If the timer or counter is specified as a device in the argument of the CALL(P) instruction, only the current value is transmitted/received.
- Set the device numbers in the argument of the CALL(P) instruction so that they do not overlap. If they overlap, normal operation cannot be performed.

- Do not use any device used in the argument of the CALL(P) instruction in the subroutine program. If used, normal operation cannot be performed.

**Ex.**

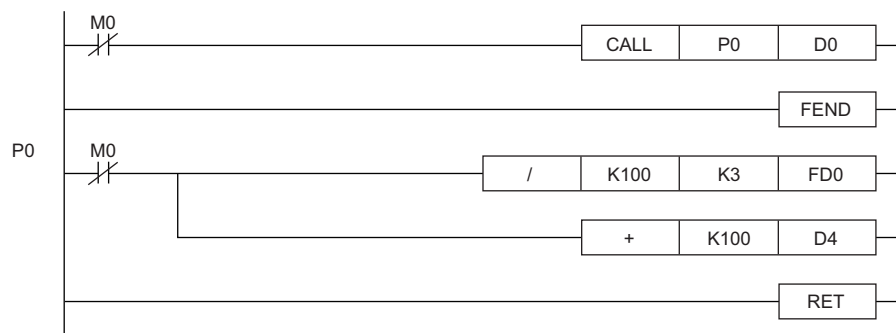
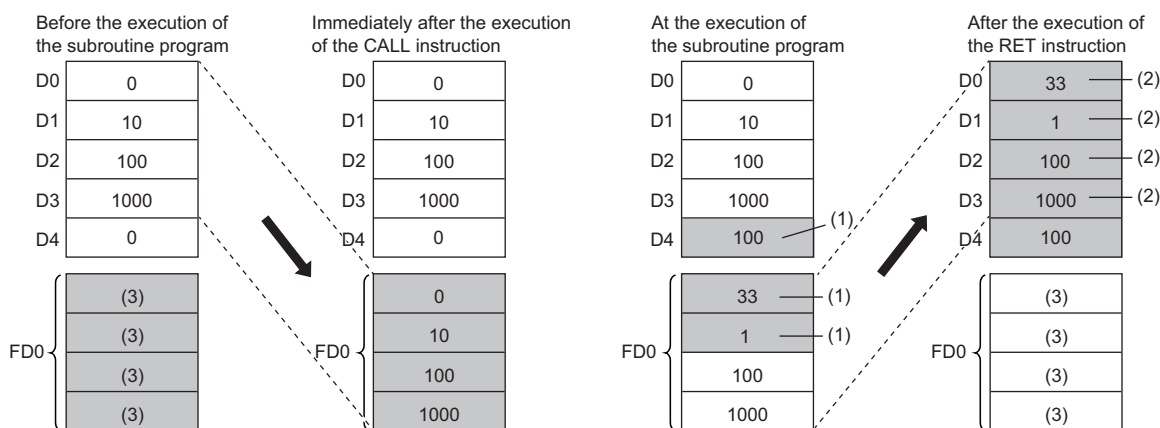
Incorrect operation: While D0 is specified for FD0 in the subroutine program, D1 is used in the subroutine program.



- (1) The operation result of the subroutine program is stored.
- (2) These values are replaced with the function device values.
- (3) The value of D1 is not replaced with the function device value.
- (4) Undefined values are stored.

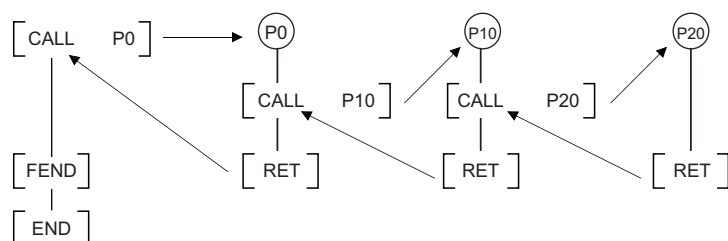
**Ex.**

Correct operation: While D0 is specified for FD0 in the subroutine program, D4 is used in the subroutine program.



- (1) The operation result of the subroutine program is stored.
- (2) These values are replaced with the function device values.
- (3) Undefined values are stored.

- Up to 16 CALL(P) instructions can be nested. Note that the 16-level nesting is the total of the CALL(P), FCALL(P), ECALL(P), EFCALL(P), and XCALL instructions.



- Devices which are turned on in the subroutine program hold the on state even when the subroutine program is not executed. The on state can be changed to off by executing the FCALL(P) instruction.

## Precautions

- An FBD/LD program cannot be created as a subroutine program.
- FBD/LD does not support the execution of a subroutine program with an argument.
- When the pointer specified by (P) is index-modified, an error (error code: 3340H) occurs if a pointer that exists in FOR to NEXT is specified after the index modification is resolved. If a pointer that exists in FOR to NEXT is specified directly without index modification, a conversion error occurs.

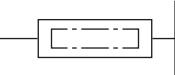
## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                              |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | The device specified in an argument from (s1) to (s5) cannot be secured for the data size.                                                                                                                                                               |
| 3330H            | The 17th level of the nesting is executed.                                                                                                                                                                                                               |
| 3340H            | The subroutine program corresponding to the pointer specified by (P) does not exist.<br>Alternatively, the pointer specified by (P) is index-modified, and the pointer that exists in FOR to NEXT is specified after the index modification is resolved. |
| 3341H            | After execution of the CALL(P) instruction, the END, FEND, GOEND, or STOP instruction is executed before the RET instruction.                                                                                                                            |
| 3342H            | The RET instruction is executed before the CALL(P) instruction.                                                                                                                                                                                          |

# Returning from the subroutine program called

## RET

This instruction indicates the end of a subroutine program.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

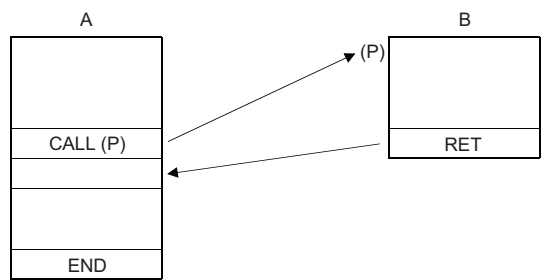
| FBD/LD        |
|---------------|
| Not supported |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| RET         | Every scan          |

### Processing details

- This instruction indicates the end of a subroutine program.
- When the instruction is executed, the program returns to the next step where the CALL(P), FCALL(P), ECALL(P), EFCALL(P), or XCALL instruction that called the subroutine program is executed.



A: Main routine program  
B: Subroutine program

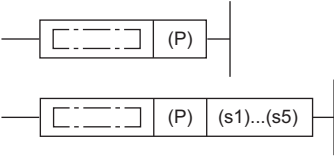
### Operation error

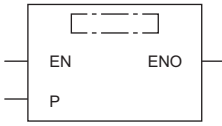
| Error code (SD0) | Description                                                                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3341H            | After execution of the CALL(P), FCALL(P), ECALL(P), EFCALL(P), or XCALL instruction, the END, FEND, GOEND, or STOP instruction is executed before the RET instruction. |
| 3342H            | The RET instruction is executed before the CALL(P), FCALL(P), ECALL(P), EFCALL(P), or XCALL instruction.                                                               |

# Calling a subroutine program and turning the output off

## FCALL(P)

These instructions perform non-execution processing of the subroutine program of the specified pointer.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| FCALL       |   |
| FCALLP      |  |

### Setting data

### Description, range, data type

| Operand                   | Description                                                         | Range                     | Data type                                     | Data type (label) |
|---------------------------|---------------------------------------------------------------------|---------------------------|-----------------------------------------------|-------------------|
| (P)                       | Start pointer number of subroutine program                          | —                         | Device name                                   | POINTER           |
| (s1)...(s5) <sup>*1</sup> | Device number to be passed to the subroutine program as an argument | -2147483648 to 2147483647 | Bit/16-bit signed binary/32-bit signed binary | ANY               |
| EN                        | Execution condition                                                 | —                         | Bit                                           | BOOL              |
| ENO                       | Execution result                                                    | —                         | Bit                                           | BOOL              |

<sup>\*1</sup> Cannot be specified in FBD/LD.

### Applicable devices

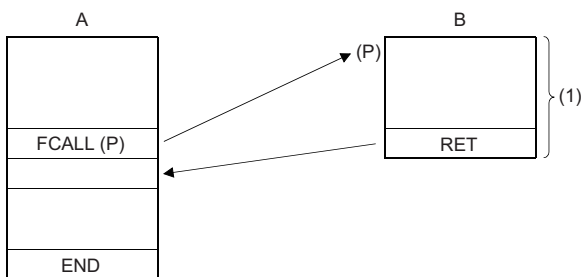
| Operand     | Bit                              |      | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|-------------|----------------------------------|------|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|             | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (P)         | —                                | —    | —                                     | —          | — | —           | —  | —                      | —        | — | —  | ○          |
| (s1)...(s5) | ○ <sup>*1</sup>                  | ○    | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |

<sup>\*1</sup> Devices other than F can be used.

## Processing details

- When the FCALL (P) instruction is executed, this instruction executes non-execution processing<sup>\*2</sup> of the subroutine program of the pointer (P). The FCALL(P) instruction can disable the execution of the subroutine program specified by a pointer in the same program file or the subroutine program specified by a global pointer.

\*2 Non-execution processing is the same as the processing performed by each coil instruction with the condition contact set to off.



A: Main routine program

B: Subroutine program

(1) Non-execution processing is performed when the command of the FCALL(P) instruction changes from on to off.

- The operation results of individual coil instructions after the end of non-execution processing are as follows regardless of on/off of the condition contact.

| Device used for operation                                        | Operation result (device status)                                   |
|------------------------------------------------------------------|--------------------------------------------------------------------|
| High-speed timer, low-speed timer                                | Set to 0                                                           |
| High-speed retentive timer, low-speed retentive timer, counter   | Maintains the current status.                                      |
| Device in OUT instruction                                        | Forcibly turned off.                                               |
| Device in the SET, RST, SFT(P), or basic/application instruction | Maintains the current status.                                      |
| PLS or pulse instruction (□P)                                    | Performs the same processing as when the condition contact is off. |

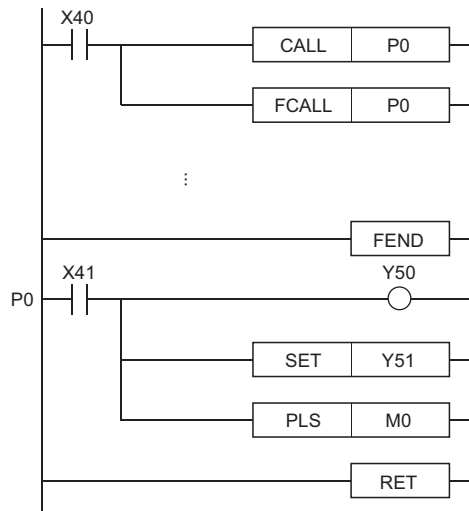
- The FCALL(P) instruction is used in combination with the CALL(P) instruction. If the FCALL(P) instruction is not used in combination with the CALL(P) instruction, non-execution processing of the subroutine program is not performed even if the execution command is turned off, and therefore the output status of each coil instruction is retained.



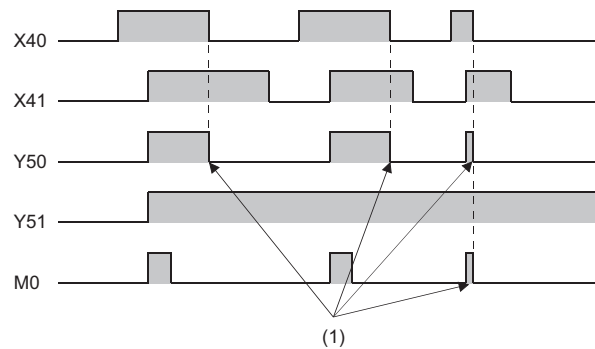
- When the execution command is turned off, non-execution processing of the subroutine program is performed, enabling the OUT instruction and PLS instruction (including pulse conversion instructions) to be forcibly turned off.

**Ex.**

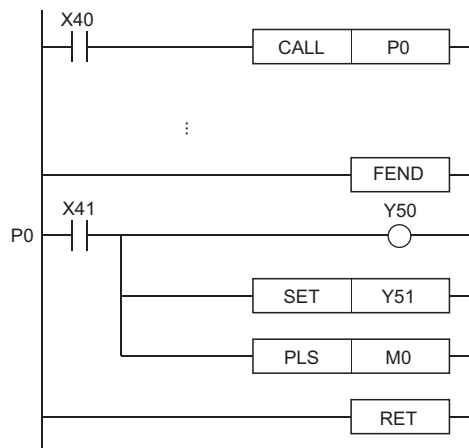
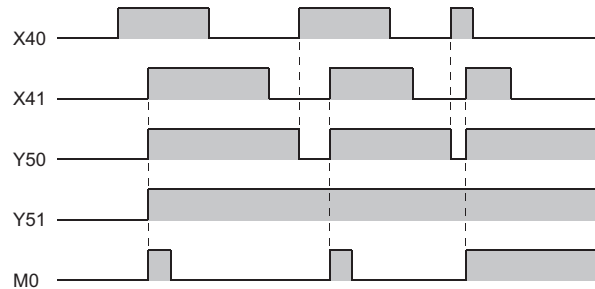
When the FCALL(P) instruction is used



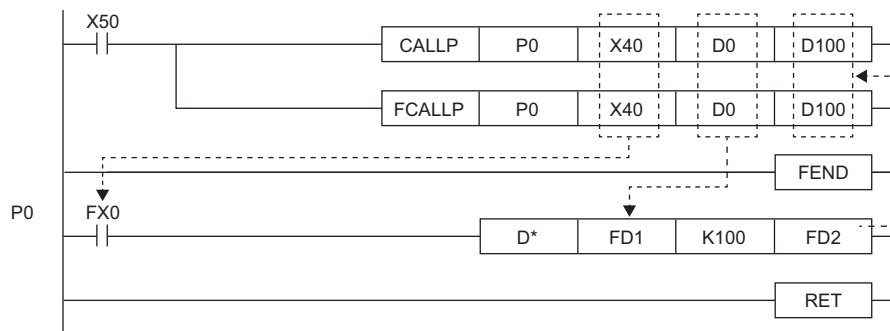
(1) Forced off by the FCALL instruction



When the FCALL(P) instruction is not used



- When the subroutine program uses function devices (FX, FY, FD), specify the devices corresponding to the function devices in (s1) to (s5). The following figure the contents of the devices specified by (s1) to (s5).



- Before execution of the subroutine program, bit data is transferred to FX and word data is transferred to FD.
- After execution of the subroutine program, the contents of FY and FD are transferred to the corresponding devices.
- The data transfer size for FX, FY, and FD differs depending on the data type specified in (s1) to (s5).

## ■When a device is specified

Function devices FX and FY are transferred in units of bits. Function device FD is transferred in units of 4 words. The size of data to be processed varies depending on the type of the device specified by an argument.

The device specified as a function device should be secured for the data size. An error occurs if an appropriate data area cannot be secured.

The following table lists the data sizes of each function device.

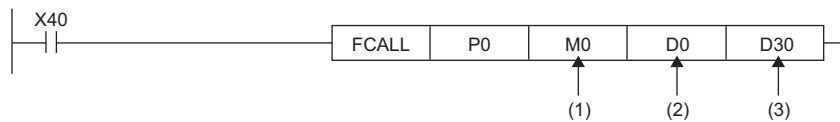
| Function device | Device to be used                        | Sizes of data when transferred to function devices from (s1) to (s5) | Sizes of data when transferred from function devices to (s1) to (s5) |
|-----------------|------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| FX, FY          | Bit device                               | 1 bit                                                                | 1 bit                                                                |
|                 | Bit-specified word device                | 1 bit                                                                | 1 bit                                                                |
| FD              | Digit-specified bit device <sup>*1</sup> | 4 words                                                              | Digit-specified size or 4 words <sup>*2</sup>                        |
|                 | Word device                              | 4 words                                                              | 4 words                                                              |

<sup>\*1</sup> It can be specified even if the device number specified by (s1) to (s5) is not a multiple of 16 in bit device digit specification mode.

<sup>\*2</sup> If the device number is a multiple of 16 and the digit specification is K4 or K8, size of 4 words will be transferred.

### Ex.

The following operation occurs when a device is specified.



(1) M0 is transferred to FX0.

(2) D0 to D3 are transferred to FD1.

(3) D30 to D33 are transferred to FD2.

## ■When a label is specified

When data is transferred to function devices from (s1) to (s5), function devices FX and FY are transferred in units of bits.

Function device FD is transferred in units of 4 words.

When data is transferred from function devices to (s1) to (s5), function devices FX and FY are transferred in units of bits. The unit of transfer for function device FD is the label-assigned size unit.

The following table lists the data sizes of each function device.

| Function device | Label-assigned size | Sizes of data when transferred to function devices from (s1) to (s5) | Sizes of data when transferred from function devices to (s1) to (s5) |
|-----------------|---------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| FX, FY          | 1 bit               | 1 bit                                                                | 1 bit                                                                |
| FD              | 2 bits or more      | 4 words <sup>*1</sup>                                                | Label-assigned size <sup>*2</sup>                                    |

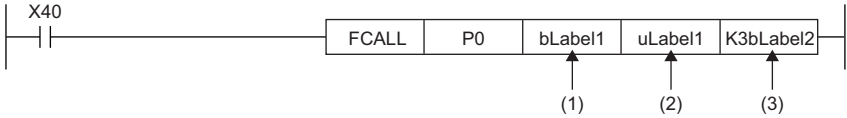
<sup>\*1</sup> If the assigned size of the specified label/structure is less than 4 words, 0 is transferred for the area that is less than 4 words.

<sup>\*2</sup> If the assigned size of the specified label/structure is 4 words or more, 4 words are transferred.

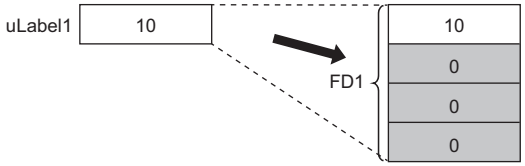
**Ex.**

The following table lists the label names and label types when data is transferred to function devices from (s1) to (s5).

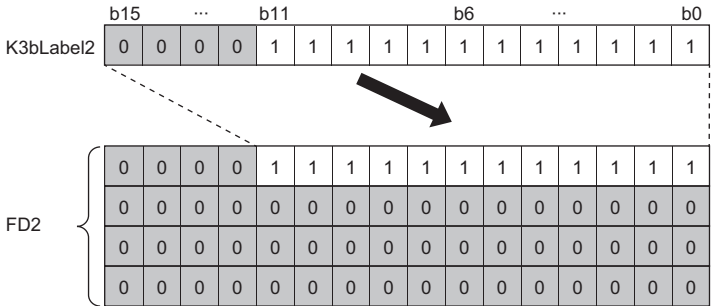
| Label name | Label type           |
|------------|----------------------|
| bLabel1    | Bit type label       |
| uLabel1    | Word type label      |
| bLabel2    | Array bit type label |



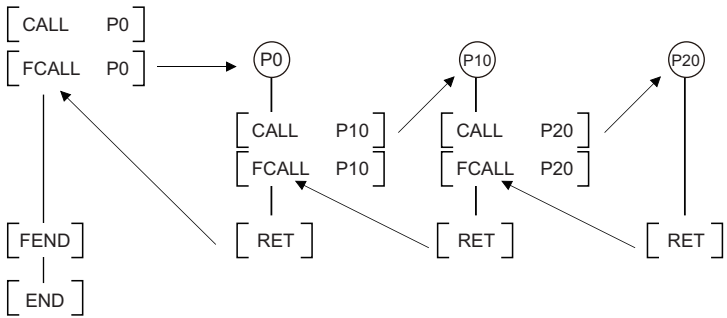
- (1) bLabel1 (1 bit) is transferred to FX0.
- (2) uLabel1 (1 word) is transferred to FD1. Since the assigned size is less than 4 words, 0 is transferred for the area that is less than 4 words.



- (3) 1 word of K3bLabel2 is transferred to FD2. Since the assigned size is less than 4 words, 0 is transferred for the area that is less than 4 words.



- The FCALL(P) instruction can use (s1) to (s5).
- Up to 16 FCALL(P) instructions can be nested. Note that the 16-level nesting is the total of the CALL(P), FCALL(P), ECALL(P), EFCALL(P), and XCALL instructions.



## Precautions

- An FBD/LD program cannot be created as a subroutine program.
- FBD/LD does not support the execution of a subroutine program with an argument.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                   |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | The device specified in an argument from (s1) to (s5) cannot be secured for the data size.                                                                                                                                                                                    |
| 3330H            | The 17th level of the nesting is executed.                                                                                                                                                                                                                                    |
| 3340H            | The subroutine program corresponding to the pointer specified by the FCALL(P) instruction does not exist.<br>Alternatively, the pointer specified by (P) is index-modified, and the pointer that exists in FOR to NEXT is specified after the index modification is resolved. |
| 3341H            | After execution of the FCALL(P) instruction, the END, FEND, GOEND, or STOP instruction is executed before the RET instruction.                                                                                                                                                |
| 3342H            | The RET instruction is executed before the FCALL(P) instruction.                                                                                                                                                                                                              |

# Calling a subroutine program in the specified program file

## ECALL(P)

These instructions execute the subroutine program corresponding the specified pointer of the specified program file name.

| Ladder                 | ST            |
|------------------------|---------------|
| <p>FILE: File name</p> | Not supported |

| FBD/LD                 |
|------------------------|
| <p>FILE: File name</p> |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ECALL       |                     |
| ECALLP      |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand                   | Description                                                         | Range                     | Data type                                     | Data type (label) |
|---------------------------|---------------------------------------------------------------------|---------------------------|-----------------------------------------------|-------------------|
| (File name)               | Program file name to be called                                      | —                         | Unicode string                                | ANYSTRING_DOUBLE  |
| (P)                       | Start pointer number of subroutine program                          | —                         | Device name                                   | POINTER           |
| (s1)...(s5) <sup>*1</sup> | Device number to be passed to the subroutine program as an argument | -2147483648 to 2147483647 | Bit/16-bit signed binary/32-bit signed binary | ANY               |
| EN                        | Execution condition                                                 | —                         | Bit                                           | BOOL              |
| ENO                       | Execution result                                                    | —                         | Bit                                           | BOOL              |

\*1 Cannot be specified in FBD/LD.

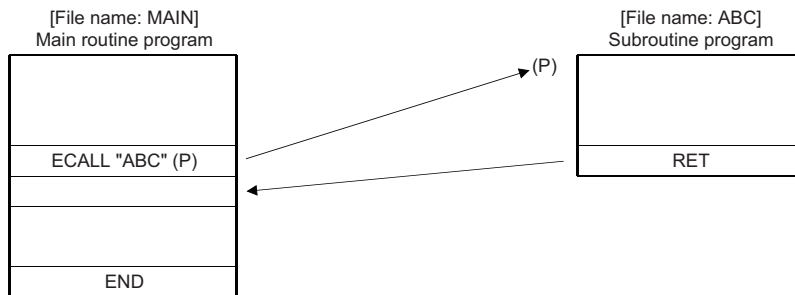
## Applicable devices

| Operand     | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|-------------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|             | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (File name) | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —          |
| (P)         | —                                | —   | —                                     | —          | — | —           | —  | —                      | —        | — | —  | ○          |
| (s1)...(s5) | ○ <sup>*1</sup>                  | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |

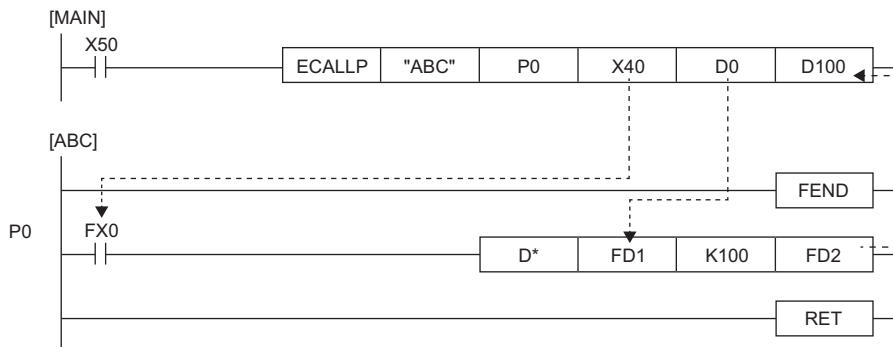
\*1 Any value other than F can be used.

## Processing details

- When the ECALL(P) instruction is executed, these instructions execute the subroutine program corresponding to the pointer specified by (P) of the specified program file name. The ECALL(P) instructions can also call the subroutine program using the local pointer of another program file.



- Only a program file stored in program memory can be specified for the file name.
- Extension ".PRG" need not be specified for the file name. (Only .PRG files can be processed by these instructions.)
- When the subroutine program uses function devices (FX, FY, FD), specify the devices corresponding to the function devices in (s1) to (s5). The following figure the contents of the devices specified by (s1) to (s5).



- Before execution of the subroutine program, bit data is transferred to FX and word data is transferred to FD.
- After execution of the subroutine program, the contents of FY and FD are transferred to the corresponding devices.
- The data transfer size for FX, FY, and FD differs depending on the data type specified in (s1) to (s5).

## ■When a device is specified

Function devices FX and FY are transferred in units of bits. Function device FD is transferred in units of 4 words. The size of data to be processed varies depending on the type of the device specified by an argument.

The device specified as a function device should be secured for the data size. An error occurs if an appropriate data area cannot be secured.

The following table lists the data sizes of each function device.

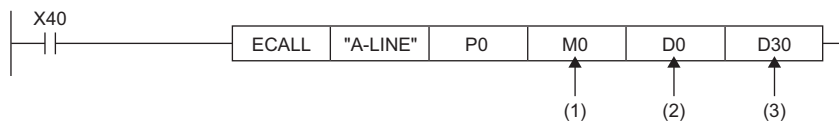
| Function device | Device to be used                        | Sizes of data when transferred to function devices from (s1) to (s5) | Sizes of data when transferred from function devices to (s1) to (s5) |
|-----------------|------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| FX, FY          | Bit device                               | 1 bit                                                                | 1 bit                                                                |
|                 | Bit-specified word device                | 1 bit                                                                | 1 bit                                                                |
| FD              | Digit-specified bit device <sup>*1</sup> | 4 words                                                              | Digit-specified size or 4 words <sup>*2</sup>                        |
|                 | Word device                              | 4 words                                                              | 4 words                                                              |

<sup>\*1</sup> It can be specified even if the device number specified by (s1) to (s5) is not a multiple of 16 in bit device digit specification mode.

<sup>\*2</sup> If the device number is a multiple of 16 and the digit specification is K4 or K8, size of 4 words will be transferred.

### Ex.

The following operation occurs when a device is specified.



(1) M0 is transferred to FX0.

(2) D0 to D3 are transferred to FD1.

(3) D30 to D33 are transferred to FD2.

## ■When a label is specified

When data is transferred to function devices from (s1) to (s5), function devices FX and FY are transferred in units of bits.

Function device FD is transferred in units of 4 words.

When data is transferred from function devices to (s1) to (s5), function devices FX and FY are transferred in units of bits. The unit of transfer for function device FD is the label-assigned size unit.

The following table lists the data sizes of each function device.

| Function device | Label-assigned size | Sizes of data when transferred to function devices from (s1) to (s5) | Sizes of data when transferred from function devices to (s1) to (s5) |
|-----------------|---------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| FX, FY          | 1 bit               | 1 bit                                                                | 1 bit                                                                |
| FD              | 2 bits or more      | 4 words <sup>*1</sup>                                                | Label-assigned size <sup>*2</sup>                                    |

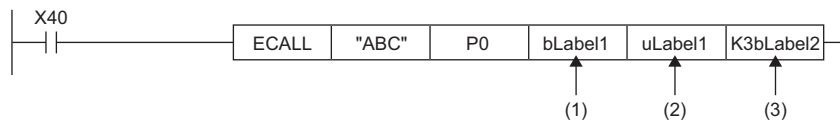
<sup>\*1</sup> If the assigned size of the specified label/structure is less than 4 words, 0 is transferred for the area that is less than 4 words.

<sup>\*2</sup> If the assigned size of the specified label/structure is 4 words or more, 4 words are transferred.

### Ex.

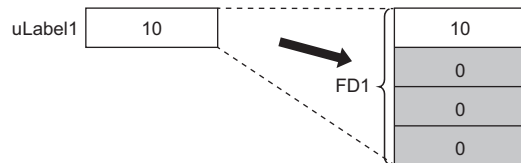
The following table lists the label names and label types when data is transferred to function devices from (s1) to (s5).

| Label name | Label type           |
|------------|----------------------|
| bLabel1    | Bit type label       |
| uLabel1    | Word type label      |
| bLabel2    | Array bit type label |

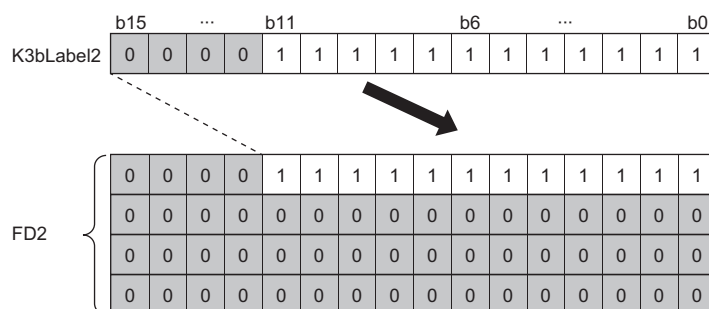


(1) bLabel1 (1 bit) is transferred to FX0.

(2) uLabel1 (1 word) is transferred to FD1. Since the assigned size is less than 4 words, 0 is transferred for the area that is less than 4 words.



(3) 1 word of K3bLabel2 is transferred to FD2. Since the assigned size is less than 4 words, 0 is transferred for the area that is less than 4 words.

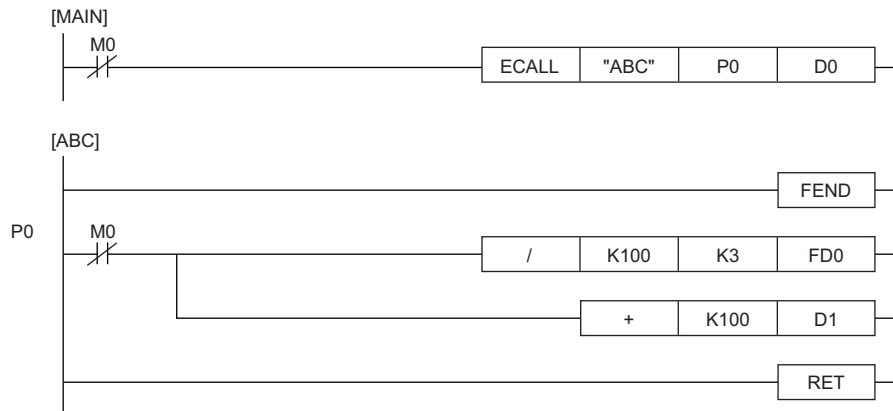
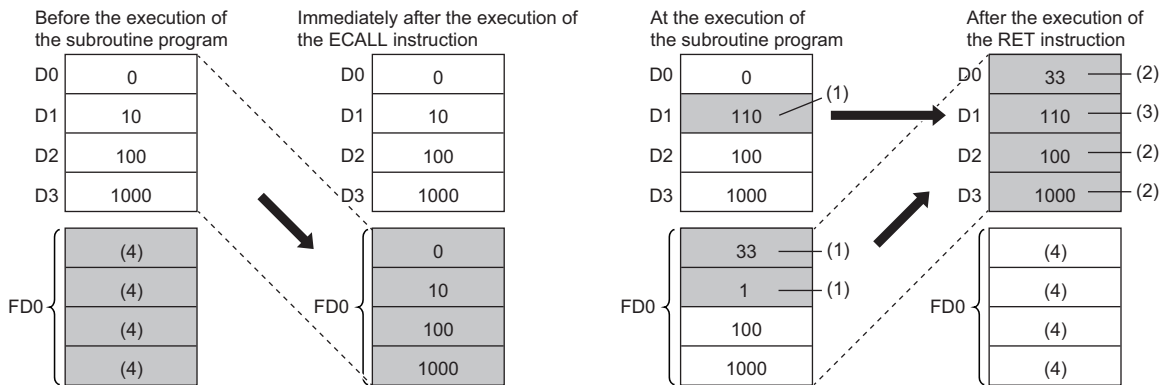




- The ECALL(P) instruction can use (s1) to (s5).
- Any device used in the argument of the ECALL(P) instruction must not be used in the subroutine program. Otherwise, normal operation cannot be performed.

**Ex.**

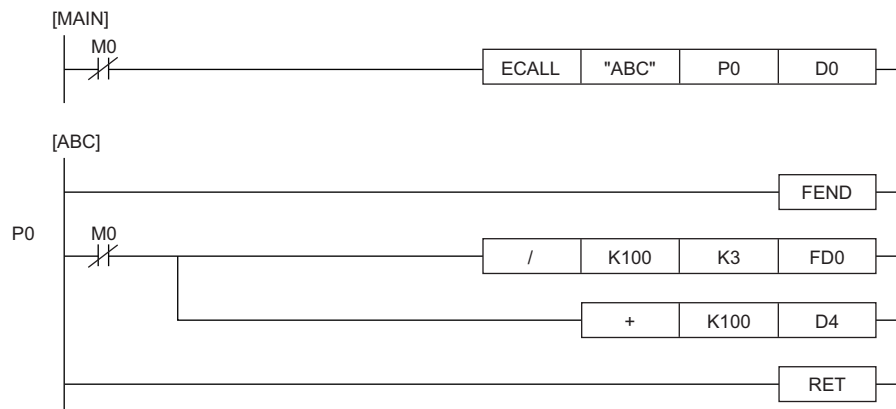
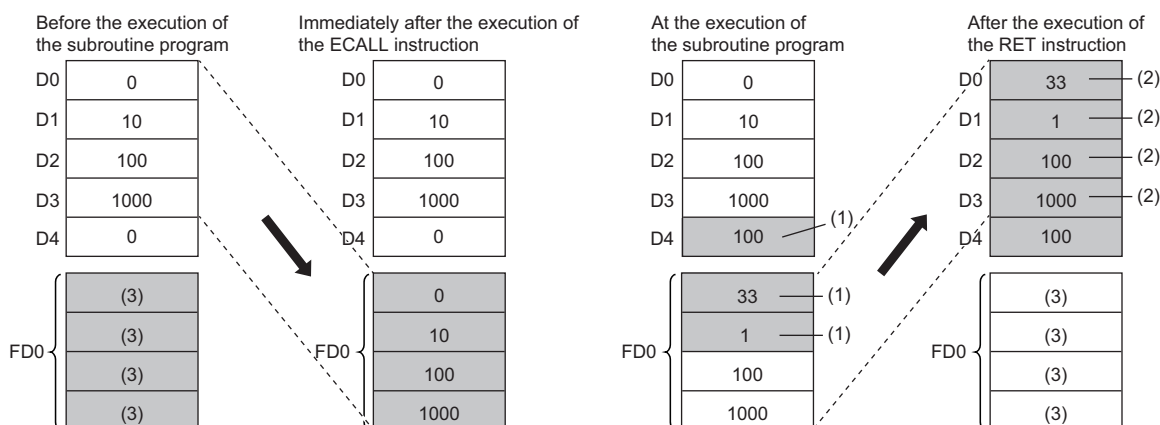
Incorrect operation: While D0 is specified for FD0 in the subroutine program, D1 is used in the subroutine program.



- (1) The operation result of the subroutine program is stored.
- (2) These values are replaced with the function device values.
- (3) The value of D1 is not replaced with the function device value.
- (4) Undefined values are stored.

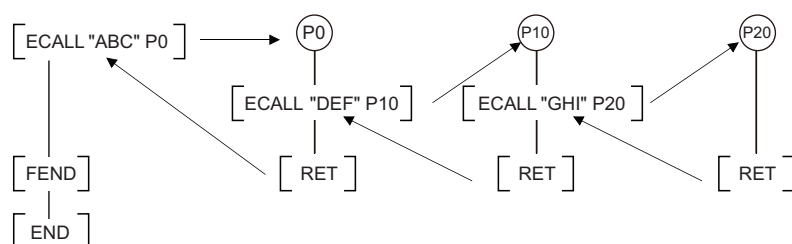
# Ex.

Correct operation: While D0 is specified for FD0 in the subroutine program, D4 is used in the subroutine program.



- (1) The operation result of the subroutine program is stored.
- (2) These values are replaced with the function device values.
- (3) Undefined values are stored.

- The device numbers specified by the ECALL(P) instruction arguments must not be overlapping. If they are overlapping, normal operation cannot be performed.
- Up to 16 ECALL(P) instructions can be nested. Note that the 16-level nesting is the total of the CALL(P), FCALL(P), ECALL(P), EFCALL(P), and XCALL instructions.



- Devices which are turned on in the subroutine program are retained even while the subroutine program is not executed. Devices which are turned on during execution of the subroutine program can be turned off by the EFCALL(P) instruction.

## Precautions

- An FBD/LD program cannot be created as a subroutine program.
- FBD/LD does not support the execution of a subroutine program with an argument.
- When the pointer specified by (P) is index-modified, an error (error code: 3340H) occurs if a pointer that exists in FOR to NEXT is specified after the index modification is resolved. If a pointer that exists in FOR to NEXT is specified directly without index modification, a conversion error occurs.

| Error code (SD0) | Description                                                                                                                                                                                                                                              |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | The device specified in an argument from (s1) to (s5) cannot be secured for the data size.                                                                                                                                                               |
| 2840H            | The file specified by (file name) does not exist.                                                                                                                                                                                                        |
| 2841H            | The file specified by (file name) cannot be executed.                                                                                                                                                                                                    |
| 2842H            | The type of the program with the file name specified by (file name) is not supported.                                                                                                                                                                    |
| 3330H            | The 17th level of the nesting is executed.                                                                                                                                                                                                               |
| 3340H            | The subroutine program corresponding to the pointer specified by (P) does not exist.<br>Alternatively, the pointer specified by (P) is index-modified, and the pointer that exists in FOR to NEXT is specified after the index modification is resolved. |
| 3341H            | After execution of the ECALL(P) instruction, the END, FEND, GOEND, or STOP instruction is executed before the RET instruction.                                                                                                                           |
| 3342H            | The RET instruction is executed before the ECALL(P) instruction.                                                                                                                                                                                         |

# Calling a subroutine program in the specified program file and turning the output off

## EFCALL(P)

These instructions perform non-execution processing of the subroutine program corresponding the specified pointer of the specified program file name.

| Ladder                 | ST            |
|------------------------|---------------|
| <p>FILE: File name</p> | Not supported |

| FBD/LD                 |
|------------------------|
| <p>FILE: File name</p> |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| EFCALL      |                     |
| EFCALLP     |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand                    | Description                                                         | Range                     | Data type                                     | Data type (label) |
|----------------------------|---------------------------------------------------------------------|---------------------------|-----------------------------------------------|-------------------|
| (File name)                | Program file name subject to non-execution processing               | —                         | Unicode string                                | ANYSTRING_DOUBLE  |
| (P)                        | Start pointer number of subroutine program                          | —                         | Device name                                   | POINTER           |
| (s1) to (s5) <sup>*1</sup> | Device number to be passed to the subroutine program as an argument | -2147483648 to 2147483647 | Bit/16-bit signed binary/32-bit signed binary | ANY               |
| EN                         | Execution condition                                                 | —                         | Bit                                           | BOOL              |
| ENO                        | Execution result                                                    | —                         | Bit                                           | BOOL              |

\*1 Cannot be specified in FBD/LD.

## Applicable devices

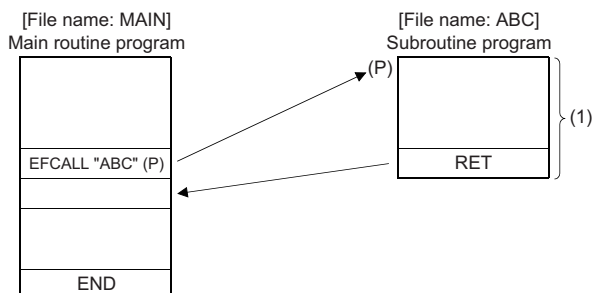
| Operand     | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|-------------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|             | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (File name) | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —          |
| (P)         | —                                | —    | —                                     | —           | — | —           | —  | —                      | —        | — | —  | ○          |
| (s1)...(s5) | ○ <sup>*1</sup>                  | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |

\*1 Any value other than F can be used.

## Processing details

- When the EFCALL(P) instruction is executed, this instruction executes non-execution processing<sup>\*2</sup> of the subroutine program of the pointer specified by (P). The EFCALL(P) instructions can also call the subroutine program using the local pointer of another program file.

\*2 Non-execution processing is the same as the processing performed by each coil instruction with the condition contact set to off.



(1) Non-execution processing is performed when the command of the EFCALL(P) instruction changes from on to off.

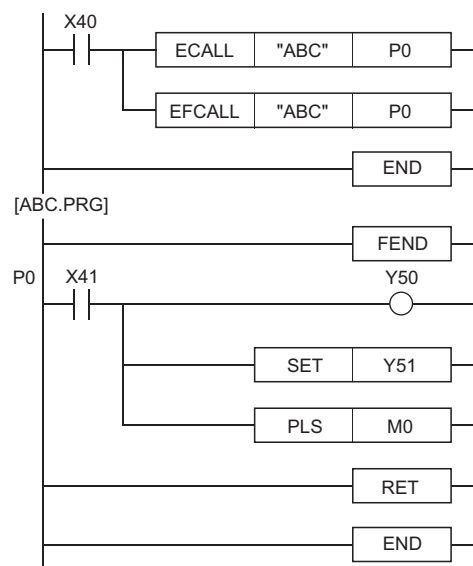
- The operation results of individual coil instructions after the end of non-execution processing are as follows regardless of on/off of the condition contact.

| Device used for operation                                        | Operation result (device status)                                   |
|------------------------------------------------------------------|--------------------------------------------------------------------|
| High-speed timer, low-speed timer                                | Set to 0                                                           |
| High-speed retentive timer, low-speed retentive timer, counter   | Maintains the current status.                                      |
| Device in OUT instruction                                        | Forcibly turned off.                                               |
| Device in the SET, RST, SFT(P), or basic/application instruction | Maintains the current status.                                      |
| PLS or pulse instruction (□P)                                    | Performs the same processing as when the condition contact is off. |

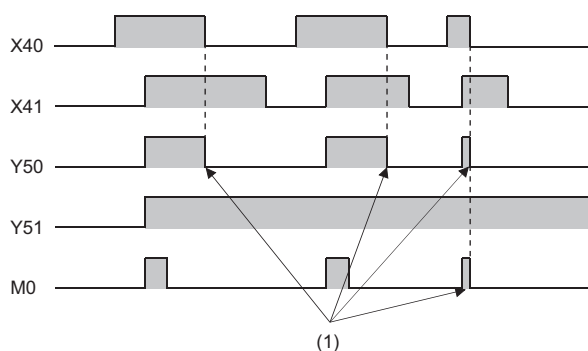
- The EFCALL(P) instruction is used in combination with the ECALL(P) instruction. If the EFCALL(P) instruction is not used in combination with the ECALL(P) instruction, non-execution processing of the subroutine program is not performed even if the execution command is turned off, and therefore the output status of each coil instruction is retained.
- When the execution command is turned off, non-execution processing of the subroutine program is performed, enabling the OUT instruction and PLS instruction (including pulse conversion instructions) to be forcibly turned off.

### Ex.

When the EFCALL (P) instruction is used

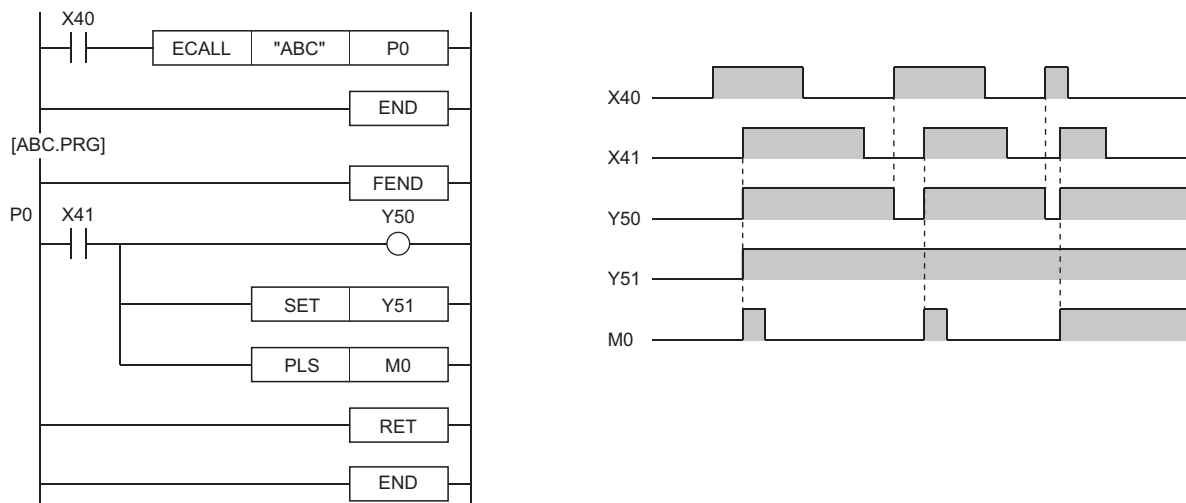


(1) Forced off by the EFCALL instruction

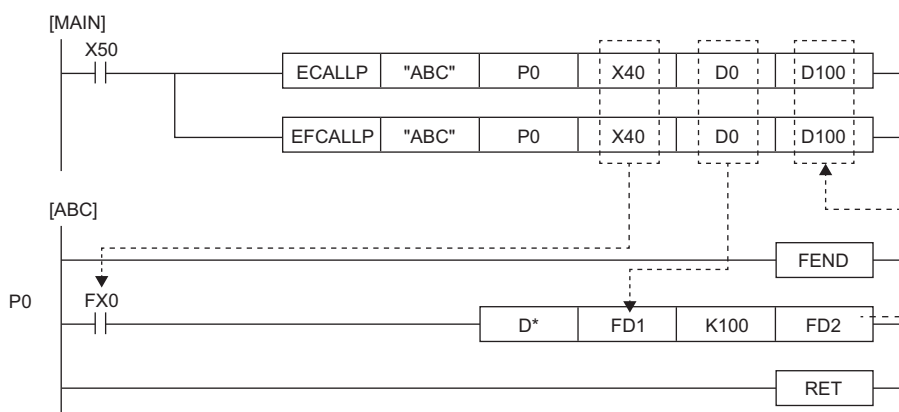


**Ex.**

When the EFCALL (P) instruction is not used



- Only a program file stored in program memory can be specified for the file name.
- Extension ".PRG" need not be specified for the file name. (Only .PRG files can be processed by these instructions.)
- When the subroutine program uses function devices (FX, FY, FD), specify the devices corresponding to the function devices in (s1) to (s5). The following figure the contents of the devices specified by (s1) to (s5).



- Before execution of the subroutine program, bit data is transferred to FX and word data is transferred to FD.
- After execution of the subroutine program, the contents of FY and FD are transferred to the corresponding devices.
- The data transfer size for FX, FY, and FD differs depending on the data type specified in (s1) to (s5).

## ■When a device is specified

Function devices FX and FY are transferred in units of bits. Function device FD is transferred in units of 4 words. The size of data to be processed varies depending on the type of the device specified by an argument.

The device specified as a function device should be secured for the data size. An error occurs if an appropriate data area cannot be secured.

The following table lists the data sizes of each function device.

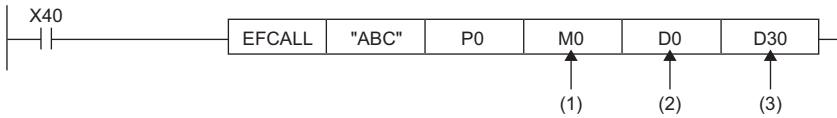
| Function device | Device to be used                        | Sizes of data when transferred to function devices from (s1) to (s5) | Sizes of data when transferred from function devices to (s1) to (s5) |
|-----------------|------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| FX, FY          | Bit device                               | 1 bit                                                                | 1 bit                                                                |
|                 | Bit-specified word device                | 1 bit                                                                | 1 bit                                                                |
| FD              | Digit-specified bit device <sup>*1</sup> | 4 words                                                              | Digit-specified size or 4 words <sup>*2</sup>                        |
|                 | Word device                              | 4 words                                                              | 4 words                                                              |

<sup>\*1</sup> It can be specified even if the device number specified by (s1) to (s5) is not a multiple of 16 in bit device digit specification mode.

<sup>\*2</sup> If the device number is a multiple of 16 and the digit specification is K4 or K8, size of 4 words will be transferred.

**Ex.**

The following operation occurs when a device is specified.



- (1) M0 is transferred to FX0.  
 (2) D0 to D3 are transferred to FD1.  
 (3) D30 to D33 are transferred to FD2.

### ■When a label is specified

When data is transferred to function devices from (s1) to (s5), function devices FX and FY are transferred in units of bits.

Function device FD is transferred in units of 4 words.

When data is transferred from function devices to (s1) to (s5), function devices FX and FY are transferred in units of bits. The unit of transfer for function device FD is the label-assigned size unit.

The following table lists the data sizes of each function device.

| Function device | Label-assigned size | Sizes of data when transferred to function devices from (s1) to (s5) | Sizes of data when transferred from function devices to (s1) to (s5) |
|-----------------|---------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| FX, FY          | 1 bit               | 1 bit                                                                | 1 bit                                                                |
| FD              | 2 bits or more      | 4 words <sup>*1</sup>                                                | Label-assigned size <sup>*2</sup>                                    |

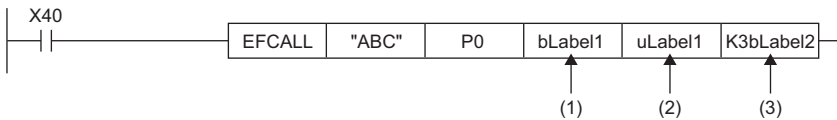
<sup>\*1</sup> If the assigned size of the specified label/structure is less than 4 words, 0 is transferred for the area that is less than 4 words.

<sup>\*2</sup> If the assigned size of the specified label/structure is 4 words or more, 4 words are transferred.

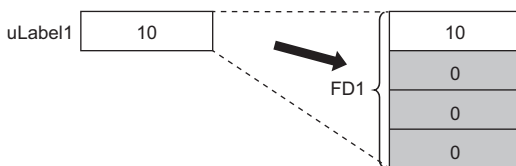
**Ex.**

The following table lists the label names and label types when data is transferred to function devices from (s1) to (s5).

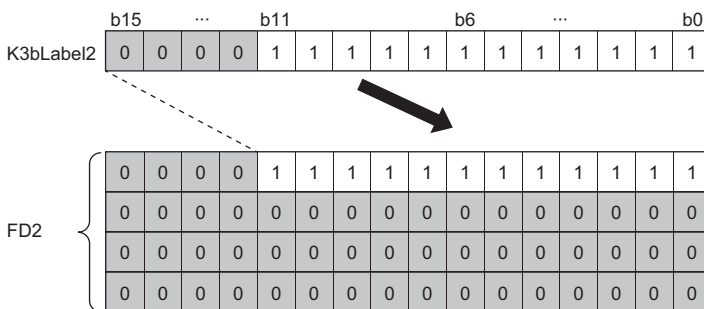
| Label name | Label type           |
|------------|----------------------|
| bLabel1    | Bit type label       |
| uLabel1    | Word type label      |
| K3bLabel2  | Array bit type label |



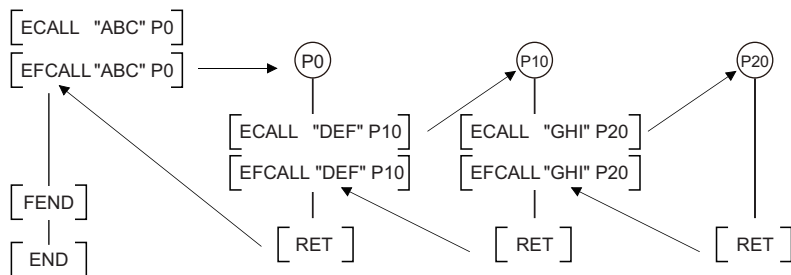
- (1) bLabel1 (1 bit) is transferred to FX0.  
 (2) uLabel1 (1 word) is transferred to FD1. Since the assigned size is less than 4 words, 0 is transferred for the area that is less than 4 words.



- (3) 1 word of K3bLabel2 is transferred to FD2. Since the assigned size is less than 4 words, 0 is transferred for the area that is less than 4 words.



- The EFCALL(P) instruction can use (s1) to (s5).
- The number of function devices used in the subroutine program must be identical to the number of arguments of the EFCALL(P) instruction. Also, the types of function devices and EFCALL(P) instruction arguments must be the same.
- Up to 16 EFCALL(P) instructions can be nested. Note that the 16-level nesting is the total of the CALL(P), FCALL(P), ECALL(P), EFCALL(P), and XCALL instructions.



## Precautions

- An FBD/LD program cannot be created as a subroutine program.
- FBD/LD does not support the execution of a subroutine program with an argument.
- When the pointer specified by (P) is index-modified, an error (error code: 3340H) occurs if a pointer that exists in FOR to NEXT is specified after the index modification is resolved. If a pointer that exists in FOR to NEXT is specified directly without index modification, a conversion error occurs.

## Operation error

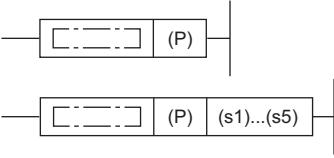
| Error code (SD0) | Description                                                                                                                                                                                                                                              |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | The device specified in an argument from (s1) to (s5) cannot be secured for the data size.                                                                                                                                                               |
| 2840H            | The file specified by (file name) does not exist.                                                                                                                                                                                                        |
| 2841H            | The file specified by (file name) cannot be executed.                                                                                                                                                                                                    |
| 3330H            | The 17th level of the nesting is executed.                                                                                                                                                                                                               |
| 3340H            | The subroutine program corresponding to the pointer specified by (P) does not exist.<br>Alternatively, the pointer specified by (P) is index-modified, and the pointer that exists in FOR to NEXT is specified after the index modification is resolved. |
| 3341H            | After execution of the EFCALL(P) instruction, the END, FEND, GOEND, or STOP instruction is executed before the RET instruction.                                                                                                                          |
| 3342H            | The RET instruction is executed before the EFCALL(P) instruction.                                                                                                                                                                                        |

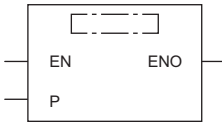


## Calling a subroutine program

### XCALL

This instruction performs execution or non-execution processing of a subroutine program. When the condition is satisfied, the instruction triggers CALL for the subroutine. When the condition turns off, the instruction triggers FCALL for the subroutine.

| Ladder                                                                            | ST            |
|-----------------------------------------------------------------------------------|---------------|
|  | Not supported |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| XCALL       |  |

### Setting data

### Description, range, data type

| Operand                   | Description                                                         | Range                     | Data type                                     | Data type (label) |
|---------------------------|---------------------------------------------------------------------|---------------------------|-----------------------------------------------|-------------------|
| (P)                       | Start pointer number of subroutine program                          | —                         | Device name                                   | POINTER           |
| (s1)...(s5) <sup>*1</sup> | Device number to be passed to the subroutine program as an argument | -2147483648 to 2147483647 | Bit/16-bit signed binary/32-bit signed binary | ANY               |
| EN                        | Execution condition                                                 | —                         | Bit                                           | BOOL              |
| ENO                       | Execution result                                                    | —                         | Bit                                           | BOOL              |

\*1 Cannot be specified in FBD/LD.

### Applicable devices

| Operand     | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|-------------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|             | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (P)         | —                                | —    | —                                     | —           | — | —           | —  | —                      | —        | — | —  | ○          |
| (s1)...(s5) | ○ <sup>*1</sup>                  | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |

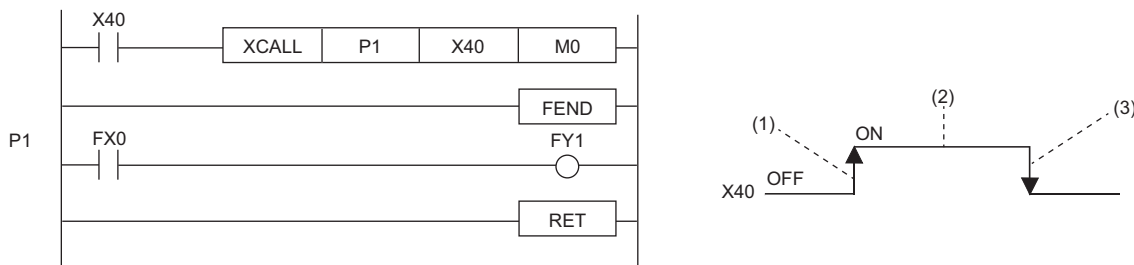
\*1 Devices other than F can be used.

## Processing details

- This instruction performs execution or non-execution processing of a subroutine program.
- For execution of the subroutine program, it operates each coil instruction according to the on/off status of condition contacts.
- For non-execution processing of the subroutine program, it operates each coil instruction in the same way as when condition contacts are off.
- The operation results of individual coil instructions after the end of non-execution processing are as follows regardless of on/off of the condition contact.

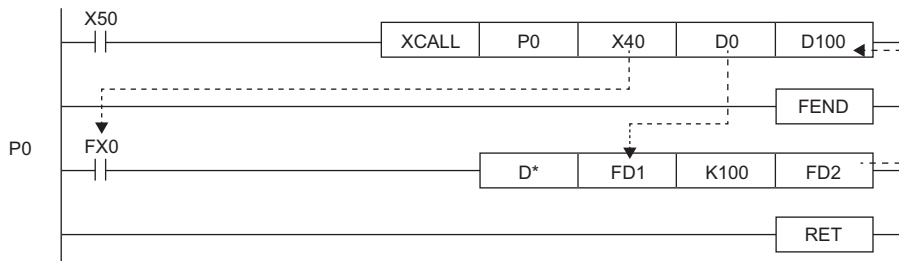
| Device used for operation                                        | Operation result (device status)                                   |
|------------------------------------------------------------------|--------------------------------------------------------------------|
| High-speed timer, low-speed timer                                | Set to 0                                                           |
| High-speed retentive timer, low-speed retentive timer, counter   | Maintains the current status.                                      |
| Device in OUT instruction                                        | Forcibly turned off.                                               |
| Device in the SET, RST, SFT(P), or basic/application instruction | Maintains the current status.                                      |
| PLS or pulse instruction (□P)                                    | Performs the same processing as when the condition contact is off. |

- The following figure shows the operation of the XCALL instruction.



- (1) On the rising edge of X40 (off→on): Executes the subroutine program specified by P1.
- (2) During X40 is on: Executes the subroutine program specified by P1. ("During X40 is on" does not include the rising edge of X40.)
- (3) On the falling edge of X40 (on→off): Performs non-execution processing of a subroutine program specified by P1.

- When the subroutine program uses function devices (FX, FY, FD), specify the devices corresponding to the function devices in (s1) to (s5). The following figure the contents of the devices specified by (s1) to (s5).



- Before execution of the subroutine program, bit data is transferred to FX and word data is transferred to FD.
- After execution of the subroutine program, the contents of FY and FD are transferred to the corresponding devices.
- The data transfer size for FX, FY, and FD differs depending on the data type specified in (s1) to (s5).

### ■When a device is specified

Function devices FX and FY are transferred in units of bits. Function device FD is transferred in units of 4 words. The size of data to be processed varies depending on the type of the device specified by an argument.

The device specified as a function device should be secured for the data size. An error occurs if an appropriate data area cannot be secured.

The following table lists the data sizes of each function device.

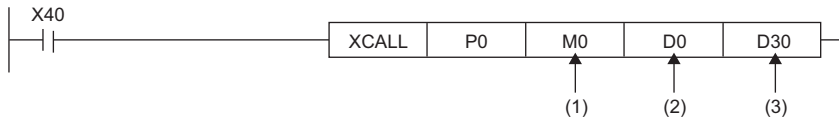
| Function device | Device to be used                        | Sizes of data when transferred to function devices from (s1) to (s5) | Sizes of data when transferred from function devices to (s1) to (s5) |
|-----------------|------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| FX, FY          | Bit device                               | 1 bit                                                                | 1 bit                                                                |
|                 | Bit-specified word device                | 1 bit                                                                | 1 bit                                                                |
| FD              | Digit-specified bit device <sup>*1</sup> | 4 words                                                              | Digit-specified size or 4 words <sup>*2</sup>                        |
|                 | Word device                              | 4 words                                                              | 4 words                                                              |

<sup>\*1</sup> It can be specified even if the device number specified by (s1) to (s5) is not a multiple of 16 in bit device digit specification mode.

<sup>\*2</sup> If the device number is a multiple of 16 and the digit specification is K4 or K8, size of 4 words will be transferred.

**Ex.**

The following operation occurs when a device is specified.



- (1) M0 is transferred to FX0.  
 (2) D0 to D3 are transferred to FD1.  
 (3) D30 to D33 are transferred to FD2.

### ■When a label is specified

When data is transferred to function devices from (s1) to (s5), function devices FX and FY are transferred in units of bits. Function device FD is transferred in units of 4 words.

When data is transferred from function devices to (s1) to (s5), function devices FX and FY are transferred in units of bits. The unit of transfer for function device FD is the label-assigned size unit.

The following table lists the data sizes of each function device.

| Function device | Label-assigned size | Sizes of data when transferred to function devices from (s1) to (s5) | Sizes of data when transferred from function devices to (s1) to (s5) |
|-----------------|---------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|
| FX, FY          | 1 bit               | 1 bit                                                                | 1 bit                                                                |
| FD              | 2 bits or more      | 4 words* <sup>1</sup>                                                | Label-assigned size* <sup>2</sup>                                    |

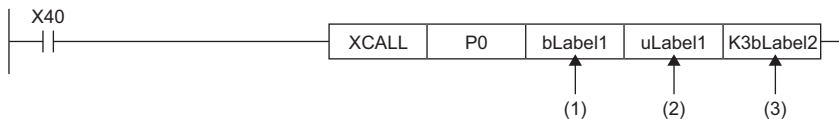
\*1 If the assigned size of the specified label/structure is less than 4 words, 0 is transferred for the area that is less than 4 words.

\*2 If the assigned size of the specified label/structure is 4 words or more, 4 words are transferred.

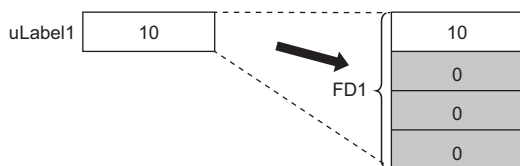
**Ex.**

The following table lists the label names and label types when data is transferred to function devices from (s1) to (s5).

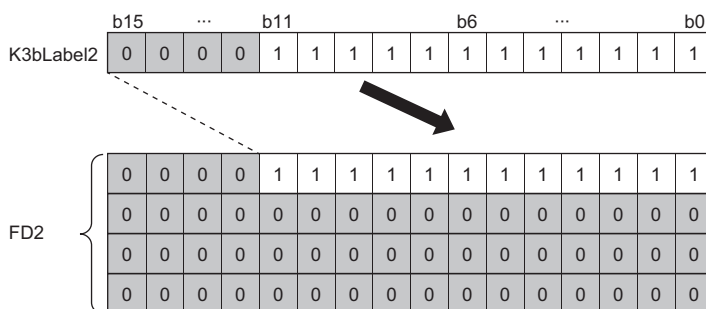
| Label name | Label type           |
|------------|----------------------|
| bLabel1    | Bit type label       |
| uLabel1    | Word type label      |
| bLabel2    | Array bit type label |



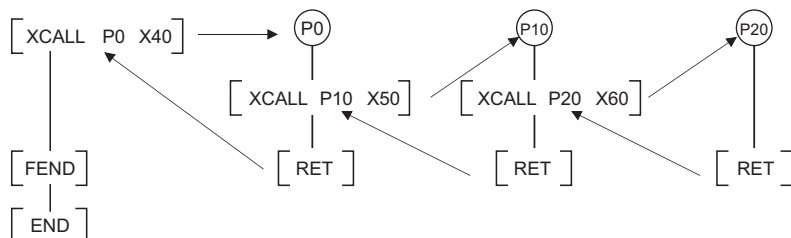
- (1) bLabel1 (1 bit) is transferred to FX0.  
 (2) uLabel1 (1 word) is transferred to FD1. Since the assigned size is less than 4 words, 0 is transferred for the area that is less than 4 words.



- (3) 1 word of K3bLabel2 is transferred to FD2. Since the assigned size is less than 4 words, 0 is transferred for the area that is less than 4 words.



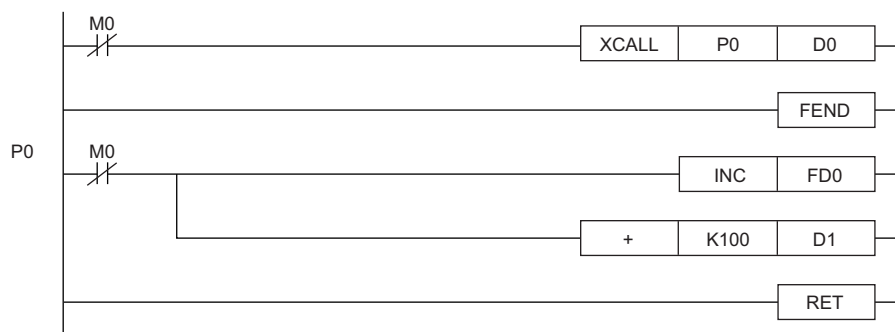
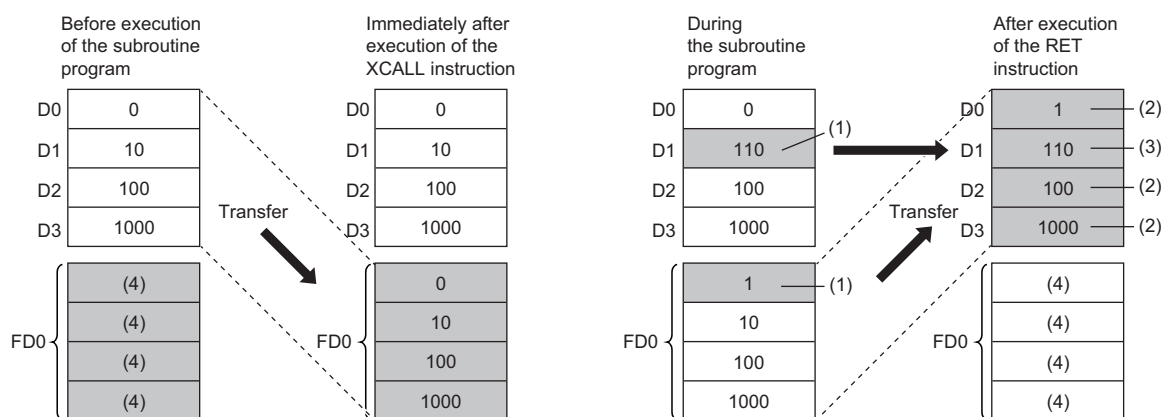
- The XCALL instruction can use (s1) to (s5).
- The number of function devices used in the subroutine program must be identical to the number of arguments of the XCALL instruction. Also, the types of function devices and XCALL instruction arguments must be the same.
- The device numbers specified by the XCALL instruction arguments must not be overlapping. If they are overlapping, normal operation cannot be performed.
- Up to 16 XCALL instructions can be nested. Note that the 16-level nesting is the total of the CALL(P), FCALL(P), ECALL(P), EFCALL(P), and XCALL instructions.



- Any device used in the argument of the XCALL instruction must not be used in the subroutine program. Otherwise, normal operation cannot be performed.

#### Ex.

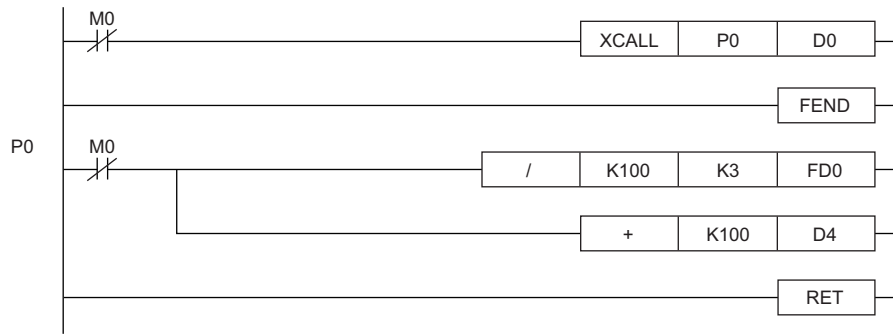
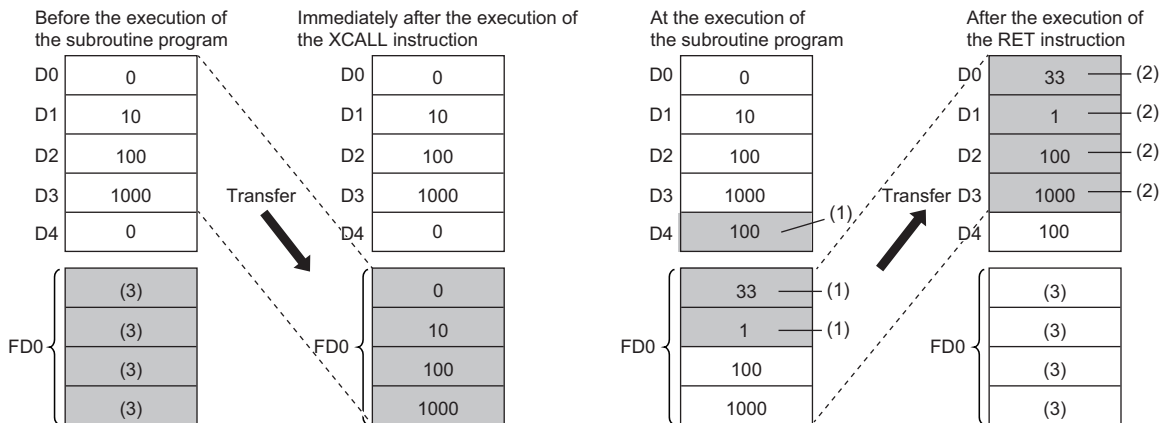
Incorrect operation: While D0 is specified for FD0 in the subroutine program, D1 is used in the subroutine program.



- (1) The operation result of the subroutine program is stored.
- (2) These values are replaced with the function device values.
- (3) The value of D1 is not replaced with the function device value.
- (4) Undefined values are stored.

**Ex.**

Correct operation: While D0 is specified for FD0 in the subroutine program, D4 is used in the subroutine program.



- (1) The operation result of the subroutine program is stored.  
 (2) These values are replaced with the function device values.  
 (3) Undefined values are stored.

## Precautions

- An FBD/LD program cannot be created as a subroutine program.
- FBD/LD does not support the execution of a subroutine program with an argument.
- When the pointer specified by (P) is index-modified, an error (error code: 3340H) occurs if a pointer that exists in FOR to NEXT is specified after the index modification is resolved. If a pointer that exists in FOR to NEXT is specified directly without index modification, a conversion error occurs.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                              |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | The device specified in an argument from (s1) to (s5) cannot be secured for the data size.                                                                                                                                                               |
| 3330H            | The 17th level of the nesting is executed.                                                                                                                                                                                                               |
| 3340H            | The subroutine program corresponding to the pointer specified by (P) does not exist.<br>Alternatively, the pointer specified by (P) is index-modified, and the pointer that exists in FOR to NEXT is specified after the index modification is resolved. |
| 3341H            | After execution of the XCALL instruction, the END, FEND, GOEND, or STOP instruction is executed before the RET instruction.                                                                                                                              |
| 3342H            | The RET instruction is executed before the XCALL instruction.                                                                                                                                                                                            |

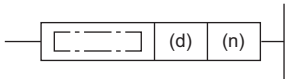
# 14 DATA PROCESSING

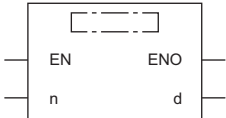
## 14.1 Rotation Instructions

### Rotating 16-bit binary data to the right

#### ROR(P), RCR(P)

- ROR(P): These instructions rotate the 16-bit binary data to the right by (n) bit(s), excluding the carry flag.
- RCR(P): These instructions rotate the 16-bit binary data to the right by (n) bit(s), including the carry flag.

| Ladder                                                                            | ST <sup>*1</sup>                                              |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------|
|  | ENO:=RORP(EN,n,d);<br>ENO:=RCR(EN,n,d);<br>ENO:=RCRP(EN,n,d); |

| FBD/LD <sup>*1</sup>                                                              |
|-----------------------------------------------------------------------------------|
|  |

<sup>\*1</sup> The ROR instruction does not support the ST and FBD/LD. Use the standard function, ROR.  
 Page 1352 ROR(\_E)

#### ■Execution condition

| Instruction  | Execution condition                                                                 |
|--------------|-------------------------------------------------------------------------------------|
| ROR<br>RCR   |  |
| RORP<br>RCRP |  |

#### Setting data

#### ■Description, range, data type

| Operand | Description                  | Range   | Data type              | Data type (label) |
|---------|------------------------------|---------|------------------------|-------------------|
| (d)     | Rotation target device       | —       | 16-bit signed binary   | ANY16             |
| (n)     | Number of bits to be rotated | 0 to 15 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition          | —       | Bit                    | BOOL              |
| ENO     | Execution result             | —       | Bit                    | BOOL              |

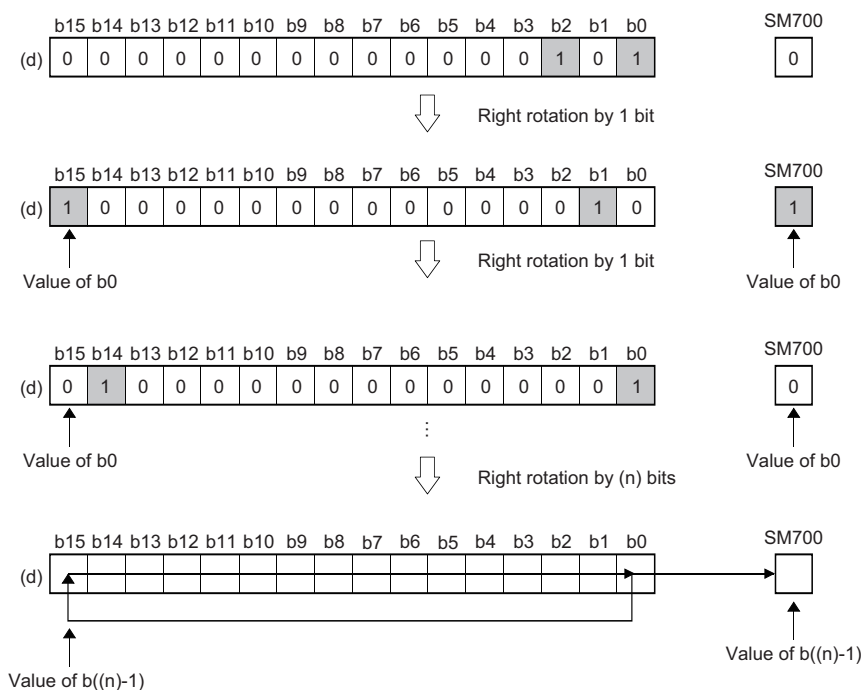
#### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

### ■ROR(P)

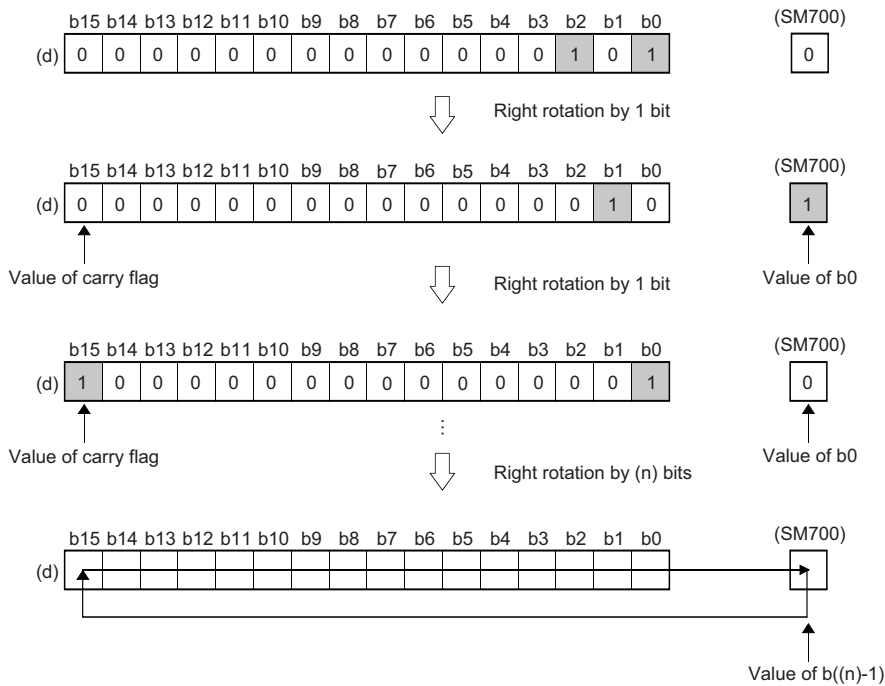
- These instructions rotate the 16-bit binary data in the device specified by (d) to the right by (n) bit(s), excluding the carry flag (SM700). The carry flag (SM700) is on or off depending on the status prior to the execution of the ROR(P) instruction.



- When (d) is a bit device, bits are rotated to the right within the device range specified by digit specification. The number of bits actually to be rotated is the remainder of  $(n) \div (\text{specified number of bits})$ . For example, when (n) is 15 and the specified number of bits is 12, 3 bits are rotated because 15 divided by 12 equals 1 with a remainder of 3.
- Specify any value between 0 and 15 for (n). If a value 16 or bigger is specified, bits are rotated by the remainder value of  $n \div 16$ . For example, when (n) is 18, 2 bits are rotated because 18 divided by 16 equals 1 with a remainder of 2.

## ■RCR(P)

- These instructions rotate the 16-bit binary data in the device specified by (d) to the right by (n) bit(s), including the carry flag (SM700). The carry flag (SM700) is on or off depending on the status prior to the execution of the RCR(P) instruction.



- When (d) is a bit device, bits are rotated to the right within the device range specified by digit specification. The number of bits actually to be rotated is the remainder of  $(n) \div (\text{specified number of bits})$ . For example, when (n) is 15 and the specified number of bits is 12, 3 bits are rotated because 15 divided by 12 equals 1 with a remainder of 3.
- Specify any value between 0 and 15 for (n). If a value 16 or bigger is specified, bits are rotated by the remainder value of  $n \div 16$ . For example, when (n) is 18, 2 bits are rotated because 18 divided by 16 equals 1 with a remainder of 2.

## Operation error

There is no operation error.



## Rotating 16-bit binary data to the left

### ROL(P), RCL(P)

- ROL(P): These instructions rotate the 16-bit binary data to the left by (n) bit(s), excluding the carry flag.
- RCL(P): These instructions rotate the 16-bit binary data to the left by (n) bit(s), including the carry flag.

| Ladder | ST <sup>*1</sup>                                              |
|--------|---------------------------------------------------------------|
|        | ENO:=ROLP(EN,n,d);<br>ENO:=RCL(EN,n,d);<br>ENO:=RCLP(EN,n,d); |

| FBD/LD <sup>*1</sup> |
|----------------------|
|                      |

\*1 The ROL instruction does not support the ST and FBD/LD. Use the standard function, ROL.

Page 1350 ROL(\_E)

### Execution condition

| Instruction  | Execution condition |
|--------------|---------------------|
| ROL<br>RCL   |                     |
| ROLP<br>RCLP |                     |

### Setting data

### Description, range, data type

| Operand | Description                  | Range   | Data type              | Data type (label) |
|---------|------------------------------|---------|------------------------|-------------------|
| (d)     | Rotation target device       | —       | 16-bit signed binary   | ANY16             |
| (n)     | Number of bits to be rotated | 0 to 15 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition          | —       | Bit                    | BOOL              |
| ENO     | Execution result             | —       | Bit                    | BOOL              |

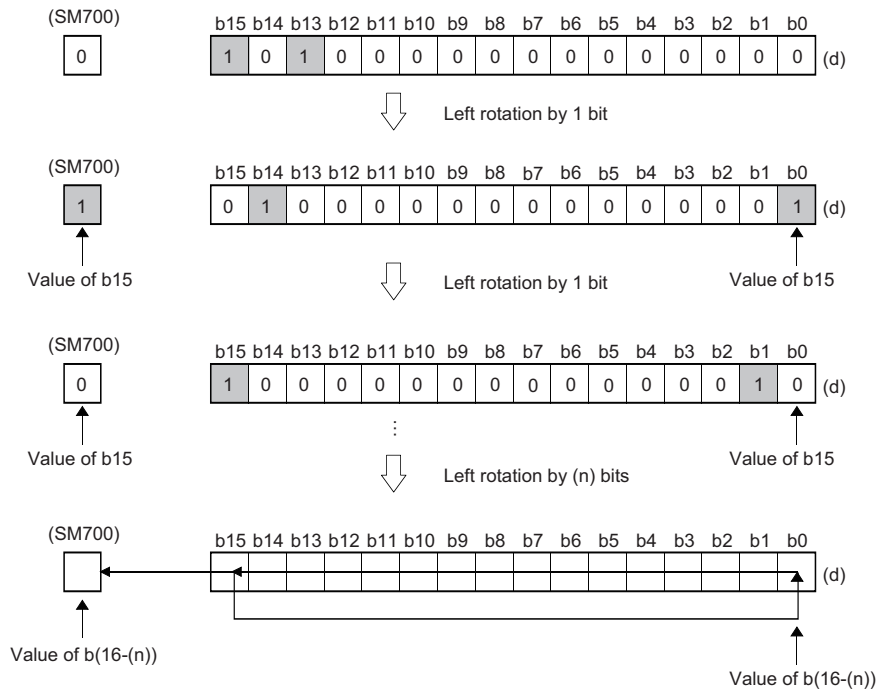
### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

### ■ROL(P)

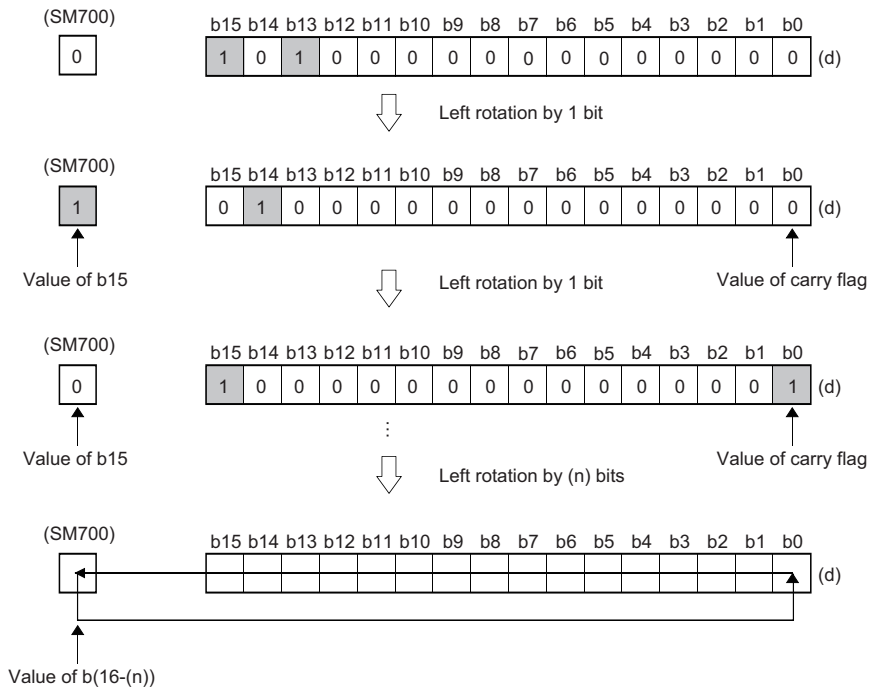
- These instructions rotate the 16-bit binary data in the device specified by (d) to the left by (n) bit(s), excluding the carry flag (SM700). The carry flag (SM700) is on or off depending on the status prior to the execution of the ROL(P) instruction.



- When (d) is a bit device, bits are rotated to the left within the device range specified by digit specification. The number of bits actually to be rotated is the remainder of  $(n) \div (\text{specified number of bits})$ . For example, when (n) is 15 and the specified number of bits is 12, 3 bits are rotated because 15 divided by 12 equals 1 with a remainder of 3.
- Specify any value between 0 and 15 for (n). If a value 16 or bigger is specified, bits are rotated by the remainder value of  $n \div 16$ . For example, when (n) is 18, 2 bits are rotated to the left because 18 divided by 16 equals 1 with a remainder of 2.

## ■RCL(P)

- These instructions rotate the 16-bit binary data in the device specified by (d) to the left by (n) bit(s), including the carry flag (SM700). The carry flag (SM700) is on or off depending on the status prior to the execution of the RCL(P) instruction.



- When (d) is a bit device, bits are rotated to the left within the device range specified by digit specification. The number of bits actually to be rotated is the remainder of  $(n) \div (\text{specified number of bits})$ . For example, when (n) is 15 and the specified number of bits is 12, 3 bits are rotated because 15 divided by 12 equals 1 with a remainder of 3.
- Specify any value between 0 and 15 for (n). If a value 16 or bigger is specified, bits are rotated by the remainder value of  $n \div 16$ . For example, when (n) is 18, 2 bits are rotated to the left because 18 divided by 16 equals 1 with a remainder of 2.

### Operation error

There is no operation error.

# Rotating 32-bit binary data to the right

## DROR(P), DRCR(P)

- DROR(P): These instructions rotate the 32-bit binary data to the right by (n) bit(s), excluding the carry flag.
- DRCR(P): These instructions rotate the 32-bit binary data to the right by (n) bit(s), including the carry flag.

| Ladder | ST*1                                                             |
|--------|------------------------------------------------------------------|
|        | ENO:=DRORP(EN,n,d);<br>ENO:=DRCR(EN,n,d);<br>ENO:=DRCRP(EN,n,d); |

| FBD/LD*1 |
|----------|
|          |

\*1 The DROR instruction does not support the ST and FBD/LD. Use the standard function, ROR.

Page 1352 ROR(\_E)

## Execution condition

| Instruction    | Execution condition |
|----------------|---------------------|
| DROR<br>DRCR   |                     |
| DRORP<br>DRCRP |                     |

## Setting data

## Description, range, data type

| Operand | Description                                           | Range   | Data type              | Data type (label) |
|---------|-------------------------------------------------------|---------|------------------------|-------------------|
| (d)     | Start device where the rotation target data is stored | —       | 32-bit signed binary   | ANY32             |
| (n)     | Number of bits to be rotated                          | 0 to 31 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition                                   | —       | Bit                    | BOOL              |
| ENO     | Execution result                                      | —       | Bit                    | BOOL              |

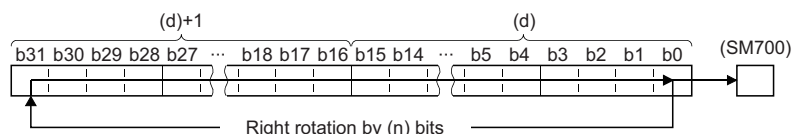
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | — |        |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | — |        |

## Processing details

### ■DROR(P)

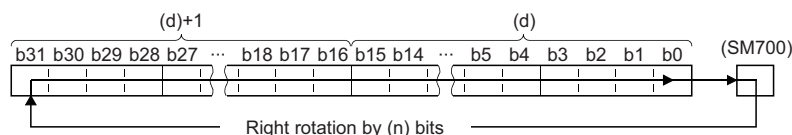
- These instructions rotate the 32-bit binary data in the device specified by (d) to the right by (n) bit(s), excluding the carry flag (SM700). The carry flag (SM700) is on or off depending on the status prior to the execution of the DROR(P) instruction.



- When (d) is a bit device, bits are rotated to the right within the device range specified by digit specification. The number of bits actually to be rotated is the remainder of  $(n) \div (\text{specified number of bits})$ . For example, when (n) is 31 and the specified number of bits is 24, 7 bits are rotated because 31 divided by 24 equals 1 with a remainder of 7.
- Specify any value between 0 and 31 for (n). If a value 32 or bigger is specified, bits are rotated by the remainder value of  $n \div 32$ . For example, when (n) is 34, 2 bits are rotated because 34 divided by 32 equals 1 with a remainder of 2.

### ■DRCR(P)

- These instructions rotate the 32-bit binary data in the device specified by (d) to the right by (n) bit(s), including the carry flag (SM700). The carry flag (SM700) is on or off depending on the status prior to the execution of the DRCR(P) instruction.



- When (d) is a bit device, bits are rotated to the right within the device range specified by digit specification. The number of bits actually to be rotated is the remainder of  $(n) \div (\text{specified number of bits})$ . For example, when (n) is 31 and the specified number of bits is 24, 7 bits are rotated because 31 divided by 24 equals 1 with a remainder of 7.
- Specify any value between 0 and 31 for (n). If a value 32 or bigger is specified, bits are rotated by the remainder value of  $n \div 32$ . For example, when (n) is 34, 2 bits are rotated because 34 divided by 32 equals 1 with a remainder of 2.

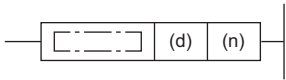
## Operation error

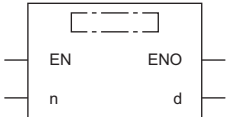
There is no operation error.

# Rotating 32-bit binary data to the left

## DROL(P), DRCL(P)

- DROL(P): These instructions rotate the 32-bit binary data to the left by (n) bit(s), excluding the carry flag.
- DRCL(P): These instructions rotate the 32-bit binary data to the left by (n) bit(s), including the carry flag.

| Ladder                                                                            | ST*1                                                             |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------|
|  | ENO:=DROLP(EN,n,d);<br>ENO:=DRCL(EN,n,d);<br>ENO:=DRCLP(EN,n,d); |

| FBD/LD*1                                                                          |
|-----------------------------------------------------------------------------------|
|  |

\*1 The DROL instruction does not support the ST and FBD/LD. Use the standard function, ROL.

Page 1350 ROL(\_E)

## Execution condition

| Instruction    | Execution condition                                                                |
|----------------|------------------------------------------------------------------------------------|
| DROL<br>DRCL   |   |
| DROLP<br>DRCLP |  |

## Setting data

## Description, range, data type

| Operand | Description                                           | Range   | Data type              | Data type (label) |
|---------|-------------------------------------------------------|---------|------------------------|-------------------|
| (d)     | Start device where the rotation target data is stored | —       | 32-bit signed binary   | ANY32             |
| (n)     | Number of bits to be rotated                          | 0 to 31 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition                                   | —       | Bit                    | BOOL              |
| ENO     | Execution result                                      | —       | Bit                    | BOOL              |

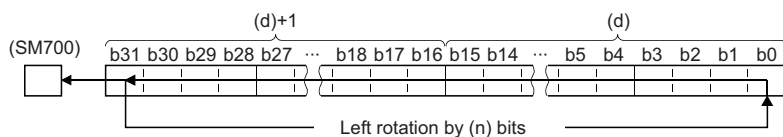
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | — |        |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | — |        |

## Processing details

### ■DROL(P)

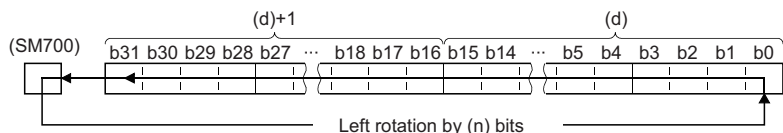
- These instructions rotate the 32-bit binary data in the device specified by (d) to the left by (n) bit(s), excluding the carry flag (SM700). The carry flag (SM700) is on or off depending on the status prior to the execution of the DROL(P) instruction.



- When (d) is a bit device, bits are rotated to the left within the device range specified by digit specification. The number of bits actually to be rotated is the remainder of  $(n) \div (\text{specified number of bits})$ . For example, when (n) is 31 and the specified number of bits is 24, 7 bits are rotated because 31 divided by 24 equals 1 with a remainder of 7.
- Specify any value between 0 and 31 for (n). If a value 32 or bigger is specified, bits are rotated by the remainder value of  $n \div 32$ . For example, when (n) is 34, 2 bits are rotated to the left because 34 divided by 32 equals 1 with a remainder of 2.

### ■DRCL(P)

- These instructions rotate the 32-bit binary data in the device specified by (d) to the left by (n) bit(s), including the carry flag (SM700). The carry flag (SM700) is on or off depending on the status prior to the execution of the DRCL(P) instruction.



- When (d) is a bit device, bits are rotated to the left within the device range specified by digit specification. The number of bits actually to be rotated is the remainder of  $(n) \div (\text{specified number of bits})$ . For example, when (n) is 31 and the specified number of bits is 24, 7 bits are rotated because 31 divided by 24 equals 1 with a remainder of 7.
- Specify any value between 0 and 31 for (n). If a value 32 or bigger is specified, bits are rotated by the remainder value of  $n \div 32$ . For example, when (n) is 34, 2 bits are rotated to the left because 34 divided by 32 equals 1 with a remainder of 2.

## Operation error

There is no operation error.

# 14.2 Data Table Operation Instructions

## Reading the oldest data from the data table

### FIFR(P)

These instructions store the data first stored in the table in the specified device.

| Ladder | ST                                        |
|--------|-------------------------------------------|
|        | ENO:=FIFR(EN,s,d);<br>ENO:=FIFRP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| FIFR        |                     |
| FIFRP       |                     |

### Setting data

#### Description, range, data type

| Operand | Description                                     | Range | Data type            | Data type (label)   |
|---------|-------------------------------------------------|-------|----------------------|---------------------|
| (s)     | Device for storing the data read from the table | —     | 16-bit signed binary | ANY16               |
| (d)     | Start device of table                           | —     | Word                 | ANY16 <sup>*1</sup> |
| EN      | Execution condition                             | —     | Bit                  | BOOL                |
| ENO     | Execution result                                | —     | Bit                  | BOOL                |

<sup>\*1</sup> When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

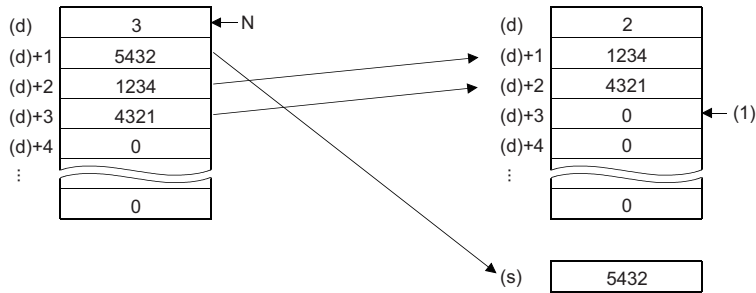
#### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —      |



## Processing details

- These instructions store the first-in data in the device specified by (d)+1 in the table specified by (d) in the device specified by (s). After execution of the FIFR(P) instruction, the data in the data table is moved forward one by one.



N: Number of data

(1) Filled with 0.

- An interlock mechanism should be used to prevent the FIFR(P) instruction from being executed when the value stored in the device specified by (d) is 0.
- A number from 0 to 65535 is stored in the number of data (d).

## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 3285H            | The FIFR(P) instruction is executed when the value in the device specified by (d) is 0. |

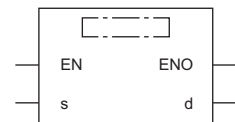
## Reading the newest data from the data table

### FPOP(P)

These instructions store the data last stored in the table in the specified device.

| Ladder | ST                                        |
|--------|-------------------------------------------|
|        | ENO:=FPOP(EN,s,d);<br>ENO:=FPOPP(EN,s,d); |

### FBD/LD



### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| FPOP        |                     |
| FPOPP       |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                     | Range | Data type            | Data type (label)   |
|---------|-------------------------------------------------|-------|----------------------|---------------------|
| (s)     | Device for storing the data read from the table | —     | 16-bit signed binary | ANY16               |
| (d)     | Start device of table                           | —     | Word                 | ANY16 <sup>*1</sup> |
| EN      | Execution condition                             | —     | Bit                  | BOOL                |
| ENO     | Execution result                                | —     | Bit                  | BOOL                |

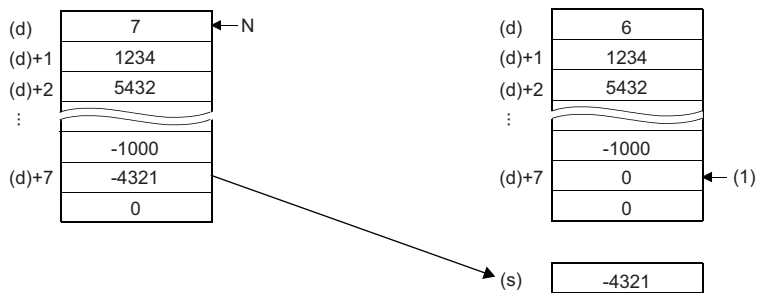
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | — | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | — | —      |

## Processing details

- These instructions store the data last stored in the table in the device specified by (d) in the device specified by (s). After execution of the FPOP(P) instruction, the device in which the data read by the instruction has been stored is cleared to 0.



N: Number of data

(1) Filled with 0.

- An interlock mechanism should be used to prevent the FPOP(P) instruction from being executed when the value stored in the device specified by (d) is 0.
- A number from 0 to 65535 is stored in the number of data (d).

## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 3285H            | The FPOP(P) instruction is executed when the value in the device specified by (d) is 0. |

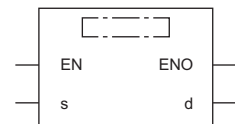
# Writing data to the data table

## FIFW(P)

These instructions transfer 16-bit binary data to the specified data table.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | <pre>ENO:=FIFW(EN,s,d); ENO:=FIFWP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| FIFW        |                     |
| FIFWP       |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                                          | Range | Data type            | Data type (label)   |
|---------|--------------------------------------------------------------------------------------|-------|----------------------|---------------------|
| (s)     | Data to be written to the table, or the device number where the write data is stored | —     | 16-bit signed binary | ANY16               |
| (d)     | Start device of table                                                                | —     | Word                 | ANY16 <sup>*1</sup> |
| EN      | Execution condition                                                                  | —     | Bit                  | BOOL                |
| ENO     | Execution result                                                                     | —     | Bit                  | BOOL                |

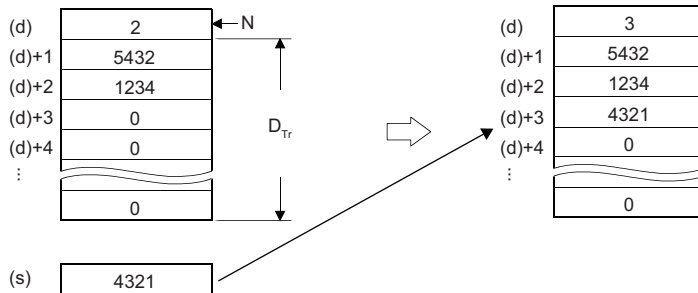
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions store the 16-bit binary data in the device specified by (s) in the data table in the device specified by (d). The number of data stored in the table is stored in (d), and the data in the device specified by (s) is stored in order in the device specified by (d)+1 and later.



N: Number of data

D<sub>Tr</sub>: Data table range (managed by users)

- When the FIFW(P) is executed for the first time, the value in the device specified by (d) must be cleared.
- A care must be taken for the data table range because data is stored sequentially in the device specified by (d)+1 and later.
- A number from 0 to 65535 is stored in the number of data (d).

## Operation error

| Error code (SD0) | Description                                                                                 |
|------------------|---------------------------------------------------------------------------------------------|
| 3285H            | The FIFW(P) instruction is executed when the value in the device specified by (d) is FFFFH. |

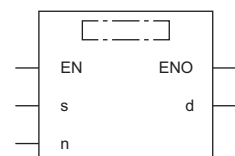
# Inserting data to the data table

## FINS(P)

These instructions insert 16-bit binary data to the (n)th position in the specified data table.

| Ladder | ST                                                   |
|--------|------------------------------------------------------|
|        | <pre>ENO:=FINS(EN,s,n,d); ENO:=FINS(EN,s,n,d);</pre> |

## FBD/LD



## Execution condition

| Instruction    | Execution condition |
|----------------|---------------------|
| FINS           |                     |
| FINS(EN,s,n,d) |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                               | Range      | Data type              | Data type (label)   |
|---------|-------------------------------------------|------------|------------------------|---------------------|
| (s)     | Device where the insertion data is stored | —          | 16-bit signed binary   | ANY16               |
| (d)     | Start device of table                     | —          | Word                   | ANY16 <sup>*1</sup> |
| (n)     | Insertion position in the table           | 0 to 65535 | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                       | —          | Bit                    | BOOL                |
| ENO     | Execution result                          | —          | Bit                    | BOOL                |

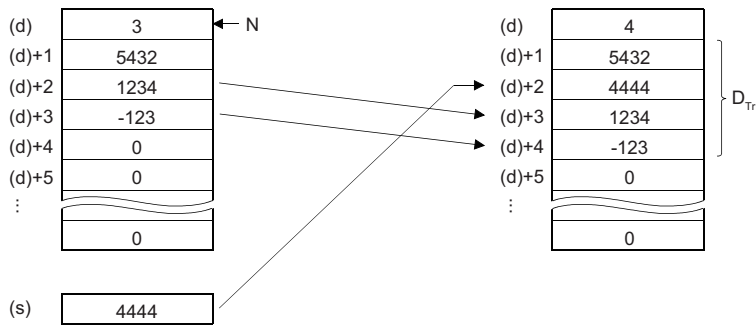
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions store the 16-bit binary data in the device specified by (s) in the (n)th position in the data table in the device specified by (d). After execution of the FINS(P) instruction, the data after the (n)th position in the data table is moved down one by one.



N: Number of data

$D_{Tr}$ : Data table range (managed by users)

When (n)=2, data is inserted to the device specified by (d)+2.

- A number from 0 to 65535 is stored in the number of data (d).

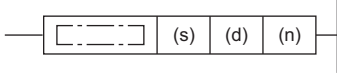
## Operation error

| Error code (SD0) | Description                                                                                                          |
|------------------|----------------------------------------------------------------------------------------------------------------------|
| 3285H            | The FINS(P) instruction is executed when the value specified by (n) is 0.                                            |
|                  | The FINS(P) instruction is executed when the value in the device specified by (d) is FFFFH.                          |
|                  | The FINS(P) instruction is executed when the value specified by (n) exceeds the number of data specified by (d) + 1. |

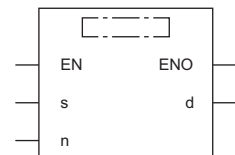
## Deleting data from data table

### FDEL(P)

These instructions delete the data at the (n)th position in the data table.

| Ladder                                                                            | ST                                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------|
|  | <pre>ENO:=FDEL(EN,s,n,d); ENO:=FDELP(EN,s,n,d);</pre> |

### FBD/LD



### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| FDEL        |  |
| FDELP       |  |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                   | Range      | Data type              | Data type (label)   |
|---------|-----------------------------------------------|------------|------------------------|---------------------|
| (s)     | Device where the data to be deleted is stored | —          | 16-bit signed binary   | ANY16               |
| (d)     | Start device of table                         | —          | Word                   | ANY16 <sup>*1</sup> |
| (n)     | Deletion position in the table                | 0 to 65535 | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                           | —          | Bit                    | BOOL                |
| ENO     | Execution result                              | —          | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

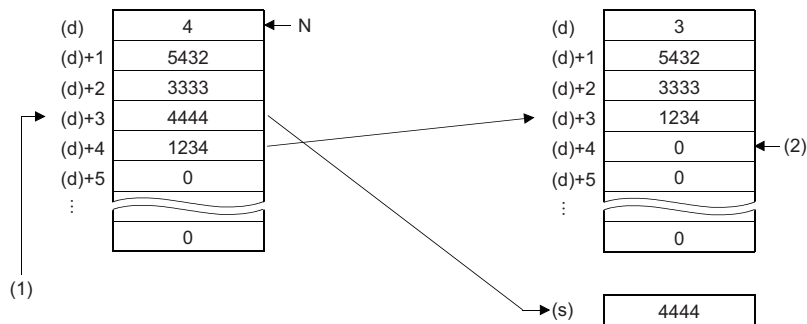
### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |



## Processing details

- These instructions delete the (n)th data in the data table in the device specified by (d) and store it in the device specified by (s). After execution of the FDEL(P) instruction, the data at the (n)+1th position and later in the data table is moved forward one by one.



N: Number of data

(1) When (n)=3, data in (d)+3 is deleted.

(2) Filled with 0.

- A number from 0 to 65535 is stored in the number of data (d).

## Operation error

| Error code (SD0) | Description                                                                                                          |
|------------------|----------------------------------------------------------------------------------------------------------------------|
| 3285H            | The FDEL(P) instruction is executed when the value specified by (n) is 0.                                            |
|                  | The FDEL(P) instruction is executed when the value in the device specified by (d) is 0.                              |
|                  | The FDEL(P) instruction is executed when the value specified by (n) exceeds the number of data specified by (d) + 1. |

# 14.3     Reading/Writing Data Instructions

## Reading/Writing data to data memory

The data write instruction is an instruction to write arbitrary device data to data memory.  
Writing the fixed values used for operation and operation results to data memory can prevent data loss when the battery is low.  
The data that has been written to data memory can be read at any time using the data memory read instruction.

### ■Execution method

Use the SP.DEVST instruction to write device data to data memory.  
Use the S(P).DEVLD instruction to read device data from data memory to any specified device.

### ■Setting method

When the SP.DEVST and S(P).DEVLD instructions are used, a device data storage file must be set up in advance.

 [CPU Parameter] ⇒ [File Setting] ⇒ [File Setting for Device Data Storage]

| File Setting for Device Data Storage |          |
|--------------------------------------|----------|
| Use Or Not Setting                   | Use      |
| Capacity                             | 1 K Word |
| File Name                            | DEVSTORE |

| Item      | Description        |
|-----------|--------------------|
| Capacity  | 1K to 512K (words) |
| File name | DEVSTORE (fixed)   |

If data memory does not have enough free space for creating a device data storage file, an error (error code: 21A1H) occurs.  
When the controller is switched from STOP to RUN, it is checked to see whether the actual device data storage file matches the parameter setting. If they do not match, an error (error code: 21A0H) occurs.

## Reading data from the data memory

### S(P).DEVLD

These instructions read data from the device data storage file in data memory.

| Ladder | ST                                                          |
|--------|-------------------------------------------------------------|
|        | <pre>ENO:=S_DEVLD(EN,s,n,d); ENO:=SP_DEVLD(EN,s,n,d);</pre> |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| S.DEVLD     |                     |
| SP.DEVLD    |                     |

### Setting data

### ■Descriptions, ranges, and data types

| Operand | Description                                                                  | Range       | Data type              | Data type (label)   |
|---------|------------------------------------------------------------------------------|-------------|------------------------|---------------------|
| (s)     | Read offset of device data storage file (specified in units of 16-bit words) | 0 to 524287 | 32-bit unsigned binary | ANY32               |
| (d)     | Device for storing the data that has been read                               | —           | Word                   | ANY16 <sup>*1</sup> |
| (n)     | Number of read points                                                        | 1 to 65535  | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                                          | —           | Bit                    | BOOL                |
| ENO     | Execution result                                                             | —           | Bit                    | BOOL                |

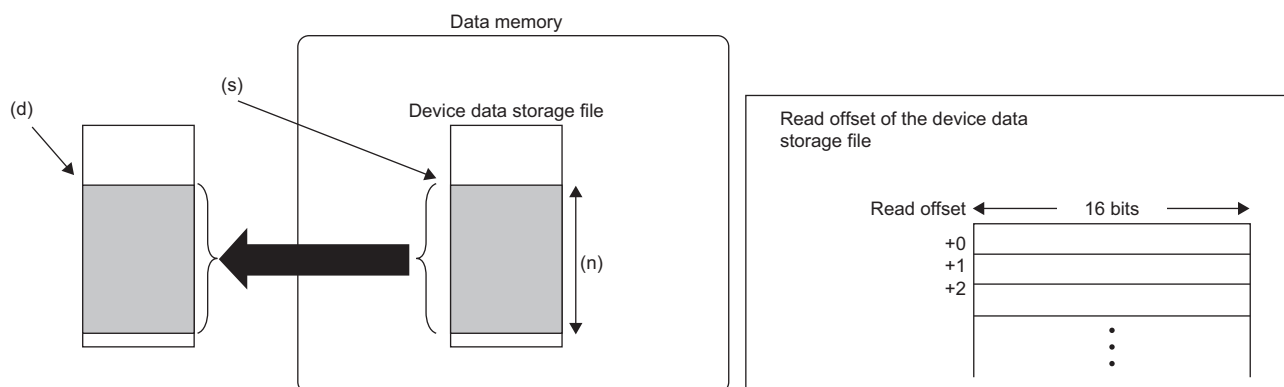
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions read device data by the number of points specified by (n) from the read offset specified by (s) in the device data storage file in data memory, and store it in the device specified by (d). (s) indicates the offset from the start of the device data storage file and can be specified by word offsets (incremented by 1 every 16 bits).



- When the S(P).DEVLD instruction is used, a device data storage file must be set up in advance. (📖 Page 608 Setting method)
- Use the SP.DEVST instruction to write device data to the device data storage file. (📖 Page 611 SP.DEVST)

## Operation error

| Error code (SD0) | Description                                           |
|------------------|-------------------------------------------------------|
| 2840H            | The device data storage file is not set in parameter. |
| 3285H            | The value specified by (n) is 0.                      |

## Writing data to the data memory

### SP.DEVST

This instruction writes the specified number of points of data to the device data storage file in data memory.

| Ladder | ST                           |
|--------|------------------------------|
|        | ENO:=SP_DEVST(EN,s1,s2,n,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SP.DEVST    |                     |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                                                   | Range       | Data type              | Data type (label)                       |
|---------|-------------------------------------------------------------------------------|-------------|------------------------|-----------------------------------------|
| (s1)    | Write offset of device data storage file (specified in units of 16-bit words) | 0 to 524287 | 32-bit unsigned binary | ANY32                                   |
| (s2)    | Start device to which data is to be written                                   | —           | Word                   | ANY16 <sup>*1</sup>                     |
| (n)     | Number of write points                                                        | 1 to 65535  | 16-bit unsigned binary | ANY16                                   |
| (d)     | (d): Completion device, (d)+1: Error completion device                        | —           | Bit                    | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                           | —           | Bit                    | BOOL                                    |
| ENO     | Execution result                                                              | —           | Bit                    | BOOL                                    |

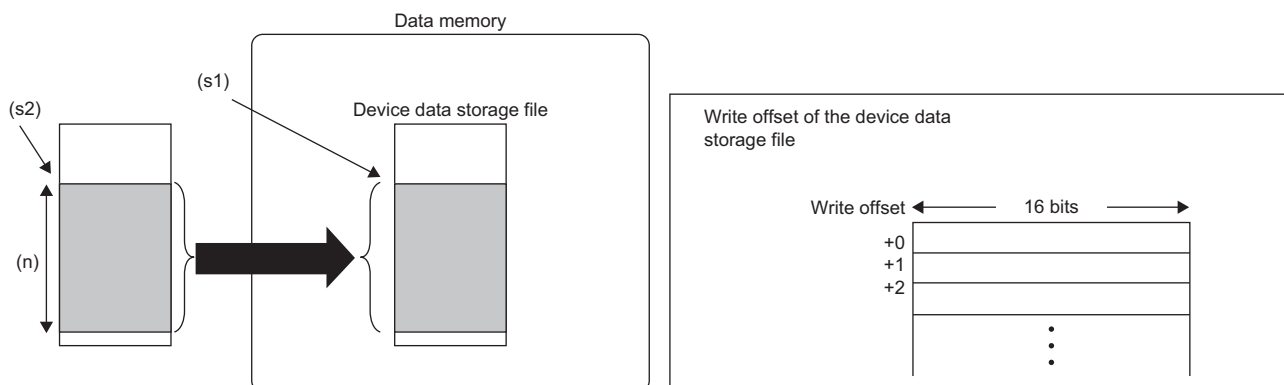
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions retrieve the specified number of points of data specified by (n) from the device specified by (s2) and write it to the write offset in the device specified by (s1) in the device data storage file in data memory. (s1) indicates the offset from the start of the device data storage file and can be specified by word offsets (incremented by 1 every 16 bits).



- The completion device specified by (d) automatically turns on upon execution of the END instruction following the detection of processing completion of the SP.DEVST instruction and turns off upon execution of the END instruction in the next scan, so it is used as the execution complete flag of the SP.DEVST instruction.
- If the SP.DEVST instruction completes with an error, the error completion device specified by (d)+1 turns on or off at the same time as the completion device specified by (d). Therefore, the device is used as the error completion flag of the SP.DEVST instruction.
- SM753 (File being accessed) turns on while the SP.DEVST instruction is being executed. If SM753 has already been on, the SP.DEVST instruction cannot be executed. (If the instruction is executed, no processing is performed.)
- If an error is detected during execution of the SP.DEVST instruction, the completion device (d), error completion device (d)+1, and SM753 do not turn on.
- When the SP.DEVST instruction is used, a device data storage file must be set up in advance. (📖 Page 608 Setting method)
- Use the S(P).DEVLD instruction to read device data from the device data storage file to any specified device. (📖 Page 609 S(P).DEVLD)

## Precautions

- The value written to data memory is the one at execution of the SP.DEVST instruction.
- Execution of the SP.DEVST instruction increases SD4124 and SD4125 (number of rewrite operations for built-in memory). The number of writes to the data memory of the controller is limited. If the data memory write count index exceeds 50000, an error occurs with error code 1080H.
- To prevent the data memory write count from being increased by careless instruction execution, SD771 can be set to limit the write count per day. The maximum number of writes is 36 by default. Change the maximum number of writes by using SD771 as needed. If the specified write count is exceeded, an error occurs with error code 3291H. The number of executions of the instruction to write to data memory per day is initialized to 0 at the following timing.
  - When power off→on, or when reset→reset canceled
  - The date (year, month, day) in clock data is changed by time advancement.
  - Controller internal clock data (year, month, day) is changed by the clock data change function.
- Data is written to the device data storage file when the END instruction is executed. Data is written to the device data storage file when the END instruction is executed immediately after the SP.DEVST instruction is executed. Thus, depending on the number of write points, writing to the device data storage file may involve multiple scans. Check the completion device to see whether the writing is completed.

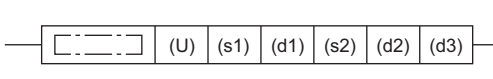
| Error code (SD0) | Description                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------------------|
| 2840H            | The device data storage file is not set in parameter.                                                       |
| 3285H            | The value specified by (n) is 0.                                                                            |
| 3291H            | When the SP.DEVST instruction is executed, the write count of the day exceeds the value specified in SD771. |
|                  | When the SP.DEVST instruction is executed, a value out of the range (1 to 32767) is set in SD771.           |

# 14.4 File Operation Instructions

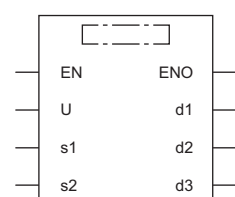
## Reading data from the specified file

### SP.FREAD

This instruction reads device data from the specified file in an SD memory card.

| Ladder                                                                            | ST                                  |
|-----------------------------------------------------------------------------------|-------------------------------------|
|  | ENO:=SP_FREAD(EN,U,s1,s2,d1,d2,d3); |

### FBD/LD



### Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| SP.FREAD    |  |

### Setting data

### Description, range, data type

| Operand | Description                                                                                                                                       | Range                                                                                                          | Data type      | Data type (label)                       |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------|
| (U)     | Dummy                                                                                                                                             | —                                                                                                              | Device name    | ANY16                                   |
| (s1)    | Drive specification                                                                                                                               | 2 (fixed)*1                                                                                                    | Word           | ANY16                                   |
| (d1)    | Start device where the control data is stored                                                                                                     |  Page 615 Control data (d1) | Word           | ANY16_ARRAY<br>(Number of elements: 8)  |
| (s2)    | Start device where the file name is stored                                                                                                        | —                                                                                                              | Unicode string | ANYSTRING_DOUBLE                        |
| (d2)    | Start device for storing the data that has been read                                                                                              | —                                                                                                              | Word           | ANY16*2                                 |
| (d3)    | Bit device that turns on upon completion of the processing<br>(In the case of an error completion, the device specified by (d3)+1 also turns on.) | —                                                                                                              | Bit            | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                                                                                               | —                                                                                                              | Bit            | BOOL                                    |
| ENO     | Execution result                                                                                                                                  | —                                                                                                              | Bit            | BOOL                                    |

\*1 Only drive 2 (for the SD memory card) can be set.

\*2 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | —                                | —   | —                                     | —          | — | —           | —  | —                      | —        | — | —  | ○          |
| (s1)    | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —          |
| (d1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —          |
| (d2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |
| (d3)    | ○                                | —   | ○                                     | —          | — | —           | —  | —                      | —        | — | —  | —          |



## ■Control data (d1)

| Operand: (d1) |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                               |        |
|---------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--------|
| Device        | Item                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Setting range                                                                 | Set by |
| +0            | Execution/completion type   | Specify the execution type.<br>■00**H: Reading binary data<br>• 0000H: 16-bit binary data<br>• 0001H: 32-bit binary data<br>■01**H: Reading data after converted to CSV format<br>• 0100H: Decimal (16-bit data)<br>• 0110H: Decimal (32-bit data)<br>• 0120H: Hexadecimal (16-bit data)<br>• 0121H: Hexadecimal (32-bit data)<br>• 0130H: String (ASCII data)<br>• 0140H: Floating point real number (single-precision real number)<br>• 0141H: Floating point real number (double-precision real number)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0000H<br>0001H<br>0100H<br>0110H<br>0120H<br>0121H<br>0130H<br>0140H<br>0141H | User   |
| +1            | Completion status           | The completion status is stored upon completion of the instruction.<br>• 0000H: Completed successfully<br>• Other than 0000H: Completed with an error (error code) (Page 663 Error codes generated for file operation instructions)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | —                                                                             | System |
| +2            | Number of read-target data  | Specify the number of read-target data (in units of words). The processing unit and setting range depend on (d1)+0.<br>■When "Reading binary data" is specified by (d1)+0<br>• When 16-bit binary data is specified: In units of words (1 to 65535) <sup>*1*2</sup><br>• When 32-bit binary data is specified: In units of double words (1 to 32767)<br>■When "Reading data after converted to CSV format" is specified by (d1)+0<br>• When decimal (16-bit data) is specified: Number of elements (1 to 65535) <sup>*1*2</sup><br>• When decimal (32-bit data) is specified: Number of elements (1 to 32767)<br>• When hexadecimal (16-bit data) is specified: Number of elements (1 to 65535)<br>• When hexadecimal (32-bit data) is specified: Number of elements (1 to 32767)<br>• When a string (ASCII data) is specified: Number of elements (1 to 1023)<br>• When a floating point real number (single-precision real number) is specified: Number of elements (1 to 32767)<br>• When a floating point real number (double-precision real number) is specified: Number of elements (1 to 16383) | 1 to 65535                                                                    | User   |
| +3            | Maximum number of read data | ■When "0130H: String (ASCII data)" is specified by (d1)+0<br>• Total size of the characters in the element (in units of words)<br>■When data other than "0130H: String (ASCII data)" is specified by (d1)+0<br>• Fixed to 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0, 1 to 65535                                                                 | User   |
| +4<br>+5      | File position               | ■When "Reading binary data" is specified by (d1)+0<br>• 00000000H: From the beginning of the file<br>• 00000001H to FFFFFFFEH: From the specified position (The data unit is determined by (d1)+7.)<br>• FFFFFFFFH: Cannot be specified.<br>■When "Reading data after converted to CSV format" is specified by (d1)+0<br>• 00000000H: From the beginning of the file<br>• 00000001H to FFFFFFFEH: From the specified row<br>• FFFFFFFFH: From the position where the previous reading ends                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 00000000H to FFFFFFFFH                                                        | User   |
| +6            | Number of columns           | When "Reading binary data" is specified by (d1)+0, set 0.<br>When "Reading data after converted to CSV format" is specified by (d1)+0, set the number of read-target columns.<br>• 0: No column (Regarded as one row.)<br>• Other than 0: Number of specified columns                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0000H to FFFFH<br>(0 to 65535)                                                | User   |
| +7            | Data type specification     | • 0: Word<br>• 1: Even number of bytes <sup>*1</sup><br>• 2: Unit of the data type specified by (d1)+0<br>• 3: Odd number of bytes <sup>*1*2</sup><br>"0: Word", "1: Even number of bytes", and "3: Odd number of bytes" can be specified only when "0000H: 16-bit binary data" or "0100H: Decimal (16-bit data)" is specified by (d1)+0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0, 1, 2, 3                                                                    | User   |

\*1 When "1: Even number of bytes" or "3: Odd number of bytes" is specified by (d1)+7 (Data type specification), the setting range of (d1)+2 (Number of read-target data) is 1 to 32767.

\*2 Even when "3: Odd number of bytes" is specified by (d1)+7 (Data type specification), specify the number in units of words. Add one byte to the odd number of bytes to be read and set the number in (d1)+2 (Number of read-target data).

## ■File name (s2)

| Operand: (s2) |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |        |
|---------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|
| Device        | Item             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Setting range  | Set by |
| +0 to +□      | File name string | <p>Specify the folder path where the files are stored and the file name.</p> <ul style="list-style-type: none"> <li>The folder path and file name (including an extension) must be within 253 characters in total.</li> <li>The folder path must be within 244 characters. (Delimiters are not included.)</li> <li>The number of folder path hierarchies must be within 10 levels.</li> <li>When omitting an extension in the file name, omit the "." (period)" as well.</li> <li>The file name (not including the extension) must be between 1 and 60 characters, and the extension must be within a period + 3 characters. If the file name (not including the extension) is 61 characters or more, the extension is ignored and replaced with ".BIN" or ".CSV".</li> </ul> <div style="text-align: center;"> <p>"/folder1/user1/user1.csv"</p> <p>(1) (2) (3)</p> </div> <p>(1) Up to 253 characters<br/> (2) Use "/" or "\" as delimiters for the folder path and file.<br/> (3) Can be omitted. When it is omitted, (1) is up to 252 characters.</p> | Unicode string | User   |

## ■Read data (d2)

| Operand: (d2) |                              |                                                                                                              |               |        |
|---------------|------------------------------|--------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item                         | Description                                                                                                  | Setting range | Set by |
| +0            | Number of data actually read | The number of data actually read is set.<br>The data unit is determined by (d1)+7 (Data type specification). | —             | System |
| +1 to +□      | Read data                    | The read data is stored.                                                                                     | —             | System |

### Processing details

- This instruction reads data from the specified file. Set the execution/completion type in the control data to specify the file read-target format.
- The read target is the data in the SD memory card only.
- The processing completion bit device (d3) automatically turns on at the execution of the END instruction in the scan in which the completion of processing of the SP.FREAD instruction is detected. The bit device (d3) turns off at the execution of the END instruction in the next scan.
- If the SP.FREAD instruction completes with an error, the error completion device (d3)+1 turns on or off in synchronization with (d3).
- SM753 (File being accessed) turns on while the SP.FREAD instruction is being executed.
- While SM753 is on, the SP.FREAD instruction cannot be executed. (If the instruction is executed, no processing is performed.)
- If an error is detected during the execution of the instruction, Processing Complete (d3), Error Completion (d3)+1, and SM753 do not turn on.
- When "Odd number of bytes" is specified by (d1)+7, the read data is stored as shown below. (In the shaded area shown below, the data before execution of the instruction is kept.)

|        | b15 | ... | b8b7 | ... | b0 |
|--------|-----|-----|------|-----|----|
| (d2)   |     |     |      |     |    |
| (d2)+1 |     |     |      |     |    |
| (d2)+2 |     |     |      |     |    |
| (d2)+3 |     |     |      |     |    |
| (d2)+4 |     |     |      |     |    |
| (d2)+5 |     |     |      |     |    |

- Specify data in (d1)+2, (d1)+4, (d1)+5, and (d2)+0 depending on the combination of (d1)+0 and (d1)+7.

| Execution/completion type<br>(d1)+0 |                              | Data type<br>specification<br>(d1)+7                                         | Processing unit and setting range        |                                         |                                           |
|-------------------------------------|------------------------------|------------------------------------------------------------------------------|------------------------------------------|-----------------------------------------|-------------------------------------------|
|                                     |                              |                                                                              | Number of read-<br>target data<br>(d1)+2 | File position<br>(d1)+4, (d1)+5         | Number of data<br>actually read<br>(d2)+0 |
| Reading binary<br>data              | 0000H: 16-bit binary<br>data | 0: Word                                                                      | Word (1 to 65535)                        | Word (00000000H to<br>7FFFFFFFH)        | Word                                      |
|                                     |                              | 1: Even number of bytes                                                      | Word (1 to 32767)                        | Byte (00000000H to<br>FFFFFFFEH)        | Byte                                      |
|                                     |                              | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Word (1 to 65535)                        | Word (00000000H to<br>7FFFFFFFH)        | Word                                      |
|                                     |                              | 3: Odd number of bytes                                                       | Word (1 to 32767)                        | Byte (00000000H to<br>FFFFFFFEH)        | Byte                                      |
|                                     | 0001H: 32-bit binary<br>data | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                    |                                         |                                           |
|                                     |                              | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Double word (1 to 32767)                 | Double word (00000000H<br>to 3FFFFFFFH) | Double word                               |
|                                     |                              | 3: Odd number of bytes                                                       | (Cannot be specified)                    |                                         |                                           |

| Execution/completion type<br>(d1)+0              |                                                                            | Data type<br>specification<br>(d1)+7                                         | Processing unit and setting range        |                                 |                                           |
|--------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------|---------------------------------|-------------------------------------------|
|                                                  |                                                                            |                                                                              | Number of read-<br>target data<br>(d1)+2 | File position<br>(d1)+4, (d1)+5 | Number of data<br>actually read<br>(d2)+0 |
| Reading data after<br>converted to CSV<br>format | 0100H: Decimal (16-<br>bit data)                                           | 0: Word                                                                      | Number of elements (1 to<br>65535)       | Number of lines                 | Word                                      |
|                                                  |                                                                            | 1: Even number of bytes                                                      | Number of elements (1 to<br>32767)       | Number of lines                 | Byte                                      |
|                                                  |                                                                            | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Number of elements (1 to<br>65535)       | Number of lines                 | Word                                      |
|                                                  |                                                                            | 3: Odd number of bytes                                                       | Number of elements (1 to<br>32767)       | Number of lines                 | Byte                                      |
|                                                  | 0110H: Decimal<br>(signed 32-bit data)                                     | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                    |                                 |                                           |
|                                                  |                                                                            | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Number of elements (1 to<br>32767)       | Number of lines                 | Double word                               |
|                                                  |                                                                            | 3: Odd number of bytes                                                       | (Cannot be specified)                    |                                 |                                           |
|                                                  | 0120H: Hexadecimal<br>(16-bit data)                                        | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                    |                                 |                                           |
|                                                  |                                                                            | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Number of elements (1 to<br>65535)       | Number of lines                 | Word                                      |
|                                                  |                                                                            | 3: Odd number of bytes                                                       | (Cannot be specified)                    |                                 |                                           |
|                                                  | 0121H: Hexadecimal<br>(32-bit data)                                        | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                    |                                 |                                           |
|                                                  |                                                                            | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Number of elements (1 to<br>32767)       | Number of lines                 | Double word                               |
|                                                  |                                                                            | 3: Odd number of bytes                                                       | (Cannot be specified)                    |                                 |                                           |
|                                                  | 0130H: String (ASCII<br>data)                                              | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                    |                                 |                                           |
|                                                  |                                                                            | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Number of elements (1 to<br>1023)        | Number of lines                 | Number of elements                        |
|                                                  |                                                                            | 3: Odd number of bytes                                                       | (Cannot be specified)                    |                                 |                                           |
|                                                  | 0140H: Floating point<br>real number (single-<br>precision real<br>number) | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                    |                                 |                                           |
|                                                  |                                                                            | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Number of elements (1 to<br>32767)       | Number of lines                 | Double word                               |
|                                                  |                                                                            | 3: Odd number of bytes                                                       | (Cannot be specified)                    |                                 |                                           |
|                                                  | 0141H: Floating point<br>real number (double-<br>precision real<br>number) | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                    |                                 |                                           |
|                                                  |                                                                            | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Number of elements (1 to<br>16383)       | Number of lines                 | 4 words                                   |
|                                                  |                                                                            | 3: Odd number of bytes                                                       | (Cannot be specified)                    |                                 |                                           |

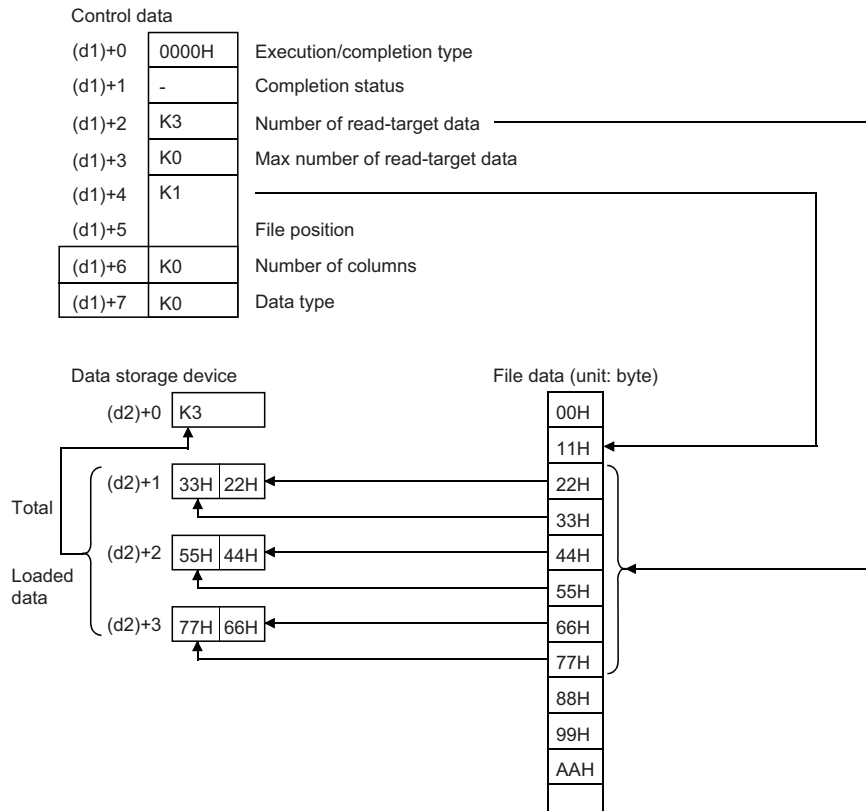
## ■When reading binary data

- If the extension of the target file is omitted, the extension will be ".BIN".
- If the specified file does not exist, an error occurs.
- If the position is specified exceeding the existing file size, 0 point of data is read and the processing completes successfully.

The following figure shows an example of reading binary data.

**Ex.**

Example of reading binary data (16-bit binary data)



## ■When reading data after converted to CSV format

- Elements in the CSV format file (cells in Excel<sup>®</sup>) are read by each row and stored in the device.
- If the extension of the target file is omitted, the extension will be ".CSV".
- If the specified file does not exist, an error occurs.
- If the position is specified exceeding the existing file size, 0 point of data is read and the processing completes successfully.
- The number of data specified by (d1)+2 is read from the beginning of the file. If the last data in the file is read before reaching to the number specified, only the available number of data is read.
- When the number of columns is set to 0, the data are read by ignoring the rows in the CSV format file.
- The string data in the CSV file and the value stored in the device after it is read are determined by the execution/completion type.

| Execution/completion type        | Data (one element) in the CSV file                                                                                                                       | Value stored in the device                      | Remarks                                                                                                                                                                                                          |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0100H: Decimal (16-bit data)     | -32768 to -1                                                                                                                                             | -32768 to -1<br>(32768 to 65535)                | The value should be within the range of -32768 to -1 as signed 16-bit data and within the range of 32768 to 65535 as unsigned 16-bit data. The same value is stored in the device.                               |
|                                  | 0 to 32767                                                                                                                                               | 0 to 32767                                      | —                                                                                                                                                                                                                |
|                                  | 32768 to 65535                                                                                                                                           | -32768 to -1<br>(32768 to 65535)                | The value should be within the range of -32768 to -1 as signed 16-bit data and within the range of 32768 to 65535 as unsigned 16-bit data. The same value is stored in the device.                               |
|                                  | <ul style="list-style-type: none"> <li>• Numeric values other than above</li> <li>• String containing alphabets and symbols</li> </ul>                   | 0                                               | Filled with 0 since it cannot be converted.                                                                                                                                                                      |
| 0110H: Decimal (32-bit data)     | -2147483648 to -1                                                                                                                                        | -2147483648 to -1<br>(2147483648 to 4294967295) | The value should be within the range of -2147483648 to -1 as signed 32-bit data and within the range of 2147483648 to 4294967295 as unsigned 32-bit data. The same value is stored in the device.                |
|                                  | 0 to 2147483647                                                                                                                                          | 0 to 2147483647                                 | —                                                                                                                                                                                                                |
|                                  | 2147483648 to 4294967295                                                                                                                                 | -2147483648 to -1<br>(2147483648 to 4294967295) | The value should be within the range of -2147483648 to -1 as signed 32-bit data and within the range of 2147483648 to 4294967295 as unsigned 32-bit data. The same value is stored in the device.                |
|                                  | <ul style="list-style-type: none"> <li>• Numeric values other than above</li> <li>• String containing alphabets and symbols</li> </ul>                   | 0                                               | Filled with 0 since it cannot be converted.                                                                                                                                                                      |
| 0120H: Hexadecimal (16-bit data) | 0H to FFFFH                                                                                                                                              | 0H to FFFFH                                     | —                                                                                                                                                                                                                |
|                                  | <ul style="list-style-type: none"> <li>• Numeric values other than above</li> <li>• String containing alphabets other than A to F and symbols</li> </ul> | 0000H                                           | Filled with 0 since it cannot be converted.                                                                                                                                                                      |
| 0121H: Hexadecimal (32-bit data) | 0H to FFFFFFFFH                                                                                                                                          | 0H to FFFFFFFFH                                 | —                                                                                                                                                                                                                |
|                                  | <ul style="list-style-type: none"> <li>• Numeric values other than above</li> <li>• String containing alphabets other than A to F and symbols</li> </ul> | 00000000H                                       | Filled with 0 since it cannot be converted.                                                                                                                                                                      |
| 0130H: String (ASCII data)       | String (up to 1999 characters)                                                                                                                           | String (up to 1999 characters)                  | NULL (00H) is added to the end of the string. When the number of bytes of the string in the CSV file is even, 0000H is stored in the next one word. When the string in the CSV file contains 00H, it is ignored. |
|                                  | String (2000 characters or more)                                                                                                                         |                                                 | If the number of characters in one element exceeds 1999, characters until the 1999th character are read as one element. The 2000th character and after are not read and the next element is read.                |

| Execution/completion type                                        | Data (one element) in the CSV file                                                                                       | Value stored in the device | Remarks                                                               |
|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------------------------------------------------------------|
| 0140H: Floating point real number (single-precision real number) | Values within the range of: $-2^{128} < \text{data} \leq -2^{-126}$ ,<br>0,<br>$2^{-126} \leq \text{data} < 2^{128}$     | As given on the left       | The value is converted in either decimal point or exponential format. |
|                                                                  | Numeric values other than above                                                                                          | 0                          | Filled with 0 since it cannot be converted.                           |
| 0141H: Floating point real number (double-precision real number) | Values within the range of: $-2^{1024} < \text{data} \leq -2^{-1022}$ ,<br>0,<br>$2^{-1022} \leq \text{data} < 2^{1024}$ | As given on the left       | The value is converted in either decimal point or exponential format. |
|                                                                  | Numeric values other than above                                                                                          | 0                          | Filled with 0 since it cannot be converted.                           |

**Ex.**

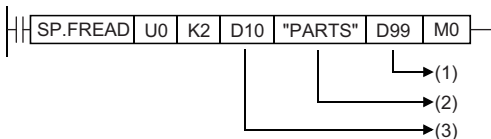
When "Reading data after converted to CSV format" (String (ASCII data)) is specified

[Data stored in CSV format]

PARTS.CSV

| No.     | , | Name   | , | Value1 | , | Value2 | CR | LF |
|---------|---|--------|---|--------|---|--------|----|----|
| AA_0001 | , | Prts_A | , | 100    | , | 200    | CR | LF |
| BB_0002 | , | Prts_B | , | 300    | , | 400    | CR | LF |

[Data to be loaded to the device]



[Control data]

|     |       |
|-----|-------|
| D10 | H0130 |
| D11 | H0000 |
| D12 | K6    |
| D13 | K100  |
| D14 | K2    |
| D15 | K2    |
| D16 | K3    |
| D17 | K2    |

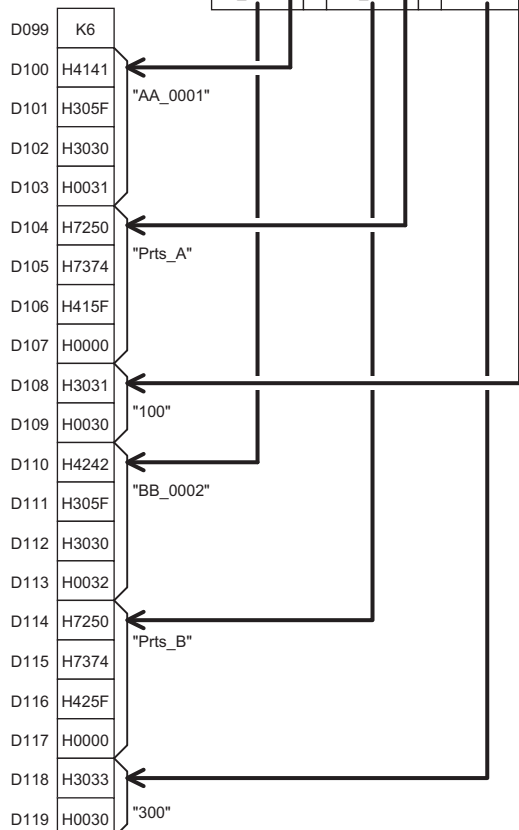
Enclosed values as shown to the left are read.  
(Total of six elements, three columns from two lines of PARTS.CSV, are read.)

- (1) Loaded data
- (2) File name
- (3) Control data

D10: Execution/completion type  
 D11: Completion status  
 D12: Number of read-target data  
 D13: Maximum number of read data  
 D14, D15: File position  
 D16: Number of columns  
 D17: Data type specification

PARTS.CSV

| No.     | , | Name   | , | Value1 | , | Value2 | CR | LF |
|---------|---|--------|---|--------|---|--------|----|----|
| AA_0001 | , | Prts_A | , | 100    | , | 200    | CR | LF |
| BB_0002 | , | Prts_B | , | 300    | , | 400    | CR | LF |



D99: Number of data actually read  
 D100 to D103: String in the 1st column of the 2nd line  
 D104 to D107: String in the 2nd column of the 2nd line  
 D108, D109: String in the 3rd column of the 2nd line  
 D110 to D113: String in the 1st column of the 3rd line  
 D114 to D117: String in the 2nd column of the 3rd line  
 D118, D119: String in the 3rd column of the 3rd line



**Ex.**

When "Reading data after converted to CSV format" (Decimal (16-bit data)) is specified and the number of columns is set to 0

[Data created in Excel]

|   | A             | B   | C              |
|---|---------------|-----|----------------|
| 1 | Main/sub item |     | Measured value |
| 2 | Length        | 1   | 3              |
| 3 | Temperature   | -21 |                |
| 4 |               |     |                |

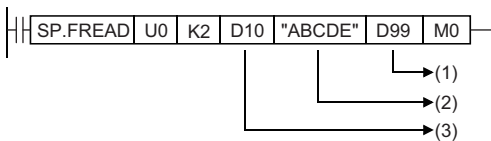


[Data saved in CSV format]

|               |   |     |                |    |       |
|---------------|---|-----|----------------|----|-------|
| Main/sub item | , | ,   | Measured value | CR | LF    |
| Length        | , | 1   | ,              | 3  | CR LF |
| Temperature   | , | -21 | ,              |    | CR LF |



[Data to be loaded to the device]



- (1) Loaded data
- (2) File name
- (3) Control data

[Control data]

|     |       |
|-----|-------|
| D10 | 0100H |
| D11 | -     |
| D12 | K9    |
| D13 | K0    |
| D14 | K0    |
| D15 | K0    |
| D16 | K0    |
| D17 | K0    |

- D10: Execution/completion type
- D11: Completion status
- D12: Number of read-target data
- D13: Maximum number of read data
- D14, D15: File position
- D16: Number of columns
- D17: Data type specification

[Loaded data]

|      |      |
|------|------|
| D99  | K9   |
| D100 | K0   |
| D101 | K0   |
| D102 | K0   |
| D103 | K0   |
| D104 | K1   |
| D105 | K3   |
| D106 | K0   |
| D107 | K-21 |
| D108 | K0   |

- D99: Number of data actually read
- D100: Since "Main/sub item" is not a numerical value, the conversion data, 0, is stored.
- D101: Since " " is not a numerical value, the conversion data, 0, is stored.
- D102: Since "Measured value" is not a numerical value, the conversion data, 0, is stored.
- D103: Since "Length" is not a numerical value, the conversion data, 0, is stored.
- D104: Since "1" is a numerical value, it is converted to a binary value.
- D105: Since "3" is a numerical value, it is converted to a binary value.
- D106: Since "Temperature" is not a numerical value, the conversion data, 0, is stored.
- D107: Since "-21" is a numerical value, it is converted to a binary value.
- D108: Since " " is not a numerical value, the conversion data, 0, is stored.

- When the number of columns differs in each row, the data are also read by ignoring the rows.

**Ex.**

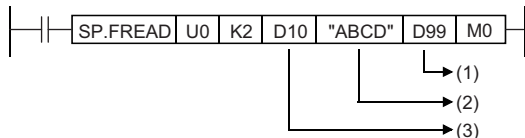
When the number of columns differs in each row

[Data saved in CSV format]

|               |    |     |   |                |    |        |    |    |
|---------------|----|-----|---|----------------|----|--------|----|----|
| Main/sub item |    | ,   |   | Measured value | ,  | Excess | CR | LF |
| Length        | CR | LF  |   |                |    |        |    |    |
| Temperature   | ,  | -21 | , | CR             | LF |        |    |    |



[Data to be loaded to the device]



- (1) Loaded data
- (2) File name
- (3) Control data

[Control data]

|     |       |
|-----|-------|
|     |       |
| D10 | 0100H |
| D11 | -     |
| D12 | K7    |
| D13 | K0    |
| D14 | K0    |
| D15 | K0    |
| D16 | K0    |
| D17 | K0    |

- D10: Execution/completion type
- D11: Completion status
- D12: Number of read-target data
- D13: Maximum number of read data
- D14, D15: File position
- D16: Number of columns
- D17: Data type specification

[Loaded data]

|      |      |
|------|------|
|      |      |
| D99  | K7   |
| D100 | K0   |
| D101 | K0   |
| D102 | K0   |
| D103 | K0   |
| D104 | K0   |
| D105 | K0   |
| D106 | K-21 |

- D99: Number of data actually read
- D100: Since "Main/sub item" is not a numerical value, the conversion data, 0, is stored.
- D101: Since " " is not a numerical value, the conversion data, 0, is stored.
- D102: Since "Measured value" is not a numerical value, the conversion data, 0, is stored.
- D103: Since "Excess" is not a numerical value, the conversion data, 0, is stored.
- D104: Since "Length" is not a numerical value, the conversion data, 0, is stored.
- D105: Since "Temperature" is not a numerical value, the conversion data, 0, is stored.
- D106: Since "-21" is a numerical value, it is converted to a binary value.



This type of file in which the number of columns vary with individual rows cannot be created by Excel. It is created when the CSV file is modified by a user.

- When the specified number of columns is set to a value other than 0, a CSV format file is read as the table with the specified number of columns. The elements outside the specified number of columns are ignored.

**Ex.**

When "Reading data after converted to CSV format" (Decimal (16-bit data)) is specified and the number of columns is set to a value other than 0 ((d1)+6 is set to 2)

[Data created in Excel]

|   | A             | B   | C              |
|---|---------------|-----|----------------|
| 1 | Main/sub item |     | Measured value |
| 2 | Length        | 1   | 3              |
| 3 | Temperature   | -21 |                |
| 4 |               |     |                |



[Data saved in CSV format]

|               |   |     |                |    |    |
|---------------|---|-----|----------------|----|----|
| Main/sub item | , | ,   | Measured value | CR | LF |
| Length        | , | 1   | , 3            | CR | LF |
| Temperature   | , | -21 |                | CR | LF |

(1)



[Data to be loaded to the device]

|          |    |    |     |        |     |    |
|----------|----|----|-----|--------|-----|----|
| SP.FREAD | U0 | K2 | D10 | "ABCD" | D99 | M0 |
|----------|----|----|-----|--------|-----|----|

(2)  
(3)  
(4)

[Control data]

|     |       |
|-----|-------|
| D10 | 0100H |
| D11 | -     |
| D12 | K6    |
| D13 | K0    |
| D14 | K0    |
| D15 | K0    |
| D16 | K2    |
| D17 | K0    |

[Loaded data]

|      |      |
|------|------|
| D99  | K6   |
| D100 | K0   |
| D101 | K0   |
| D102 | K0   |
| D103 | K1   |
| D104 | K0   |
| D105 | K-21 |

(1) The elements outside the specified number of columns are ignored.

(2) Loaded data

(3) File name

(4) Control data

D10: Execution/completion type

D11: Completion status

D12: Number of read-target data

D13: Maximum number of read data

D14, D15: File position

D16: Number of columns

D17: Data type specification

D99: Number of data actually read

D100: Since "Main/sub item" is not a numerical value, the conversion data, 0, is stored.

D101: Since " " is not a numerical value, the conversion data, 0, is stored.

D102: Since "Length" is not a numerical value, the conversion data, 0, is stored.

D103: Since "1" is a numerical value, it is converted to a binary value.

D104: Since "Temperature" is not a numerical value, the conversion data, 0, is stored.

D105: Since "-21" is a numerical value, it is converted to a binary value.

- When the number of columns differs in each row, the elements outside the specified number of columns are ignored and 0 is added to the cells where no element exists.

**Ex.**

When the number of columns differs in each row

[Data saved in CSV format]

|               |    |     |                |    |        |    |    |
|---------------|----|-----|----------------|----|--------|----|----|
| Main/sub item | ,  | ,   | Measured value | ,  | Excess | CR | LF |
| Length        | CR | LF  |                |    |        |    |    |
| Temperature   | ,  | -21 | ,              | CR | LF     |    |    |

(1)



[Data to be read into devices]

|          |    |    |     |        |     |    |
|----------|----|----|-----|--------|-----|----|
| SP.FREAD | U0 | K2 | D10 | "ABCD" | D99 | M0 |
|----------|----|----|-----|--------|-----|----|

(2)

(3)

(4)

[Control data]

|     |       |
|-----|-------|
| D10 | 0100H |
| D11 | -     |
| D12 | K6    |
| D13 | K0    |
| D14 | K0    |
| D15 | K0    |
| D16 | K2    |
| D17 | K0    |

(1) The elements outside the specified number of columns are ignored.

(2) Loaded data

(3) File name

(4) Control data

D10: Execution/completion type

D11: Completion status

D12: Number of read-target data

D13: Maximum number of read data

D14, D15: File position

D16: Number of columns

D17: Data type specification

D99: Number of data actually read

D100: Since "Main/sub item" is not a numerical value, the conversion data, 0, is stored.

D101: Since " " is not a numerical value, the conversion data, 0, is stored.

D102: Since "Length" is not a numerical value, the conversion data, 0, is stored.

D103: Since no element exists, the conversion data, 0, is added.

D104: Since "Temperature" is not a numerical value, the conversion data, 0, is stored.

D105: Since "-21" is a numerical value, it is converted to a binary value.

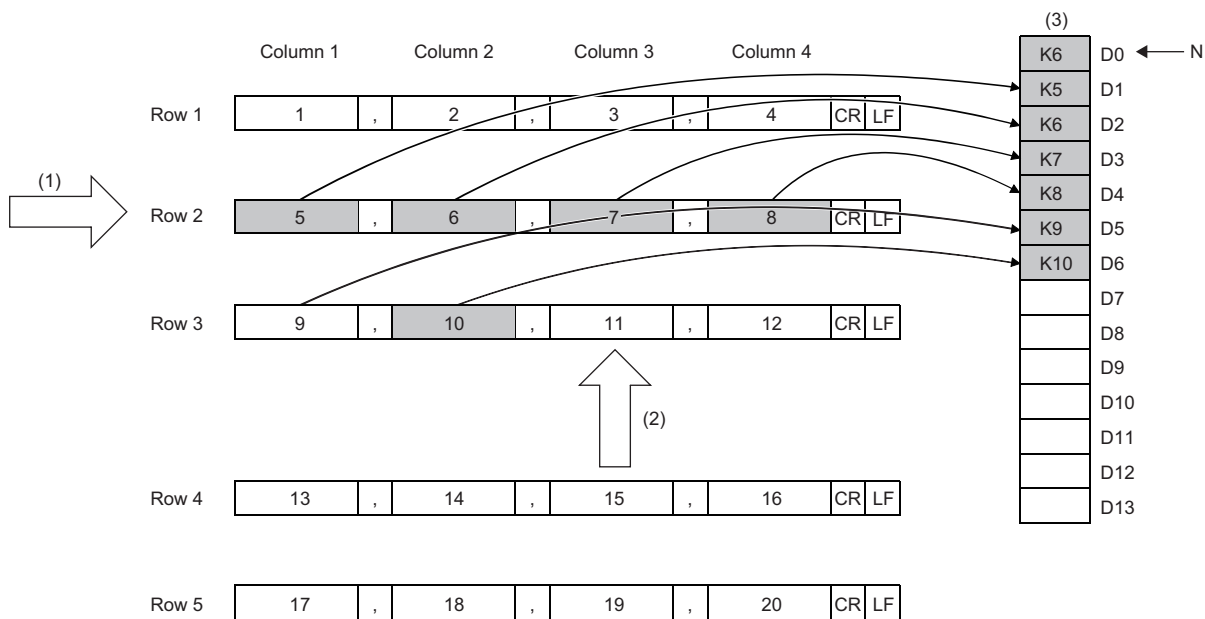
[Loaded data]

|      |      |
|------|------|
| D99  | K6   |
| D100 | K0   |
| D101 | K0   |
| D102 | K0   |
| D103 | K0   |
| D104 | K0   |
| D105 | K-21 |

- When "Reading data after converted to CSV format" is specified, data can be divided and read.

[Specify row to start reading]

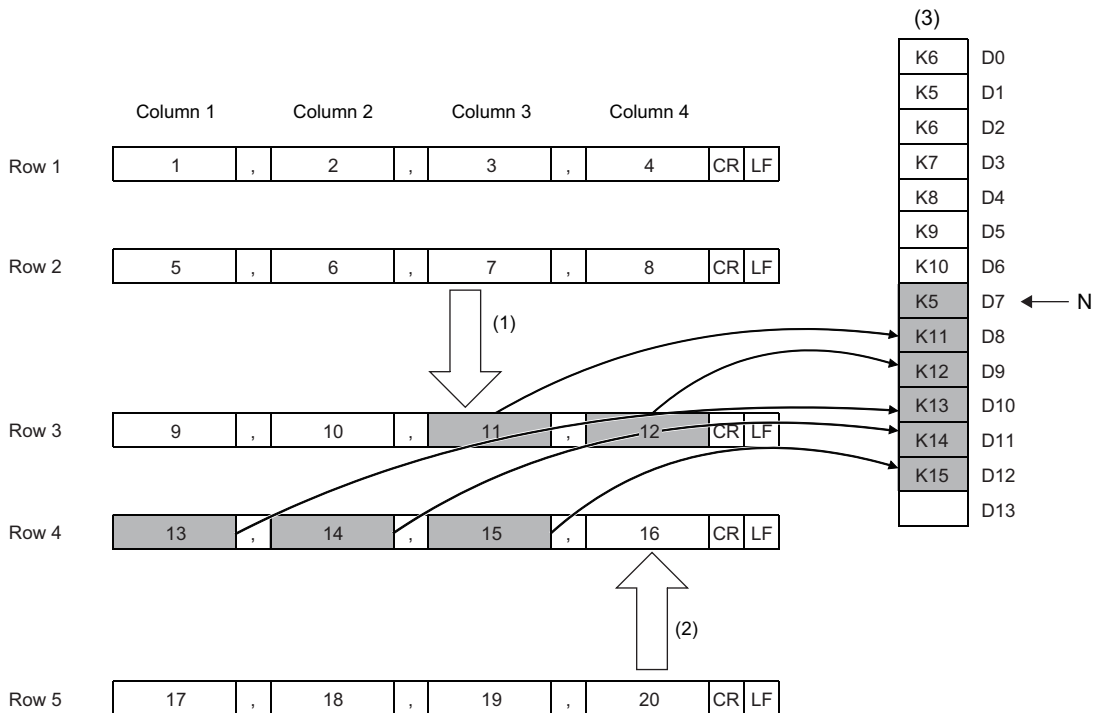
- Execution/completion type: Reading data after converted to CSV format (Decimal (16-bit binary data))
- Number of columns specification: 4H
- Data type specification: Words
- File position: 2H
- Read start device: D0
- Number of data actually read: 6H



- (1) Starting row  
 (2) Next starting position  
 (3) Data in the device (loaded data)  
 N: Number of data

[Reading data from the position where the previous reading ends]

- Execution/completion type: Reading data after converted to CSV format (Decimal (16-bit binary data))
- Number of columns specification: 4H
- Data type specification: Words
- File position: FFFFFFFFH (continuing from the position where the previous reading ends)
- Read start device: D7
- Number of data actually read: 5H



- (1) Starting row  
(2) Next starting position  
(3) Data in the device (loaded data)  
N: Number of data

**Point**

- When reading data from the position where the previous reading ends, specify the same values for "Execution/End type", "Number of columns", and "Data type specification". If not, data cannot be added correctly from the position where the previous reading ends.
- While reading data from the position where the previous reading ends, if the SP.FREAD instruction with different settings or the SP.FWRITE instruction is executed, data cannot be added correctly from the position where the previous reading ends.

## Precautions

- Do not execute this instruction in interrupt programs. Doing so may cause malfunction of the module.
- When reading multiple elements at reading data after converted to CSV format, secure devices sufficient for the total size of the elements in the read data area before executing the instruction. Since read data is stored from (d2)+1, the number of words required to be secured as (d2) is ((total number of words for each element) + 1) words.
- When "Reading data after converted to CSV format" (String (ASCII data)) is specified, set the total size (in units of words) to (d1)+3 (Maximum number of read data).  
 [Example] When reading 100 elements each of which contains 100 characters from a CSV file  
 $(100 \text{ (characters)} + 2 \text{ (NULL)}) \times 100 \text{ (elements)} = 10200 \text{ bytes} = 5100 \text{ words}$   
 Therefore, set 5100 to (d1)+3 to secure an area for 5101 words for (d2).
- Since the SP.FREAD instruction causes file reading, the scan time may be extended when this instruction is executed.
- The SP.FREAD instruction does not support character codes with BOM. If a file that uses a character code with BOM is executed, unintended data will be read. To read a CSV file with BOM that was created using Excel, use an application such as a text editor to change the character code to exclude BOM.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | Data is read exceeding the size of the device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 3285H            | The drive specified by (s1) is not the one for the SD memory card.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                  | Any value that is set in the device specified by (d1) and later as control data is out of the range.<br> Page 615 Control data (d1)                                                                                                                                                                                                                                                                                                            |
|                  | The file name string specified by (s2) cannot be read. <ul style="list-style-type: none"> <li>• The number of characters of the string in the file name specified exceeds the range.</li> <li>• An inhibited value is set.</li> <li>• The specified file name string ends with a delimiter.</li> <li>• The file name (not including the extension) of the specified file name string is 0 characters.</li> </ul>  Page 615 Control data (d1) |
| 3297H            | An invalid combination of (d1)+0 (Execution/completion type) and (d1)+7 (Data type specification) is specified.<br> Page 615 Control data (d1)                                                                                                                                                                                                                                                                                               |

If the SP.FREAD instruction completes with an error, an error code is stored in the device specified by (d1)+1. (Note that an error code is not stored if the instruction results in an operation error.)

For the error code stored in (d1)+1, refer to the following.

 Page 663 Error codes generated for file operation instructions

# Writing data to the specified file

## SP.FWRITE

This instruction writes device data to the specified file in an SD memory card.

| Ladder | ST                                   |
|--------|--------------------------------------|
|        | ENO:=SP_FWRITE(EN,U,s1,s2,s3,d1,d2); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SP.FWRITE   |                     |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                                | Range                        | Data type      | Data type (label)                       |
|---------|------------------------------------------------------------|------------------------------|----------------|-----------------------------------------|
| (U)     | Dummy                                                      | —                            | Device name    | ANY16                                   |
| (s1)    | Drive specification                                        | 2 (fixed)*1                  | Word           | ANY16                                   |
| (d1)    | Start device where the control data is stored              | ☞ Page 631 Control data (d1) | Word           | ANY16_ARRAY<br>(Number of elements: 8)  |
| (s2)    | Start device where the file name is stored                 | —                            | Unicode string | ANYSTRING_DOUBLE                        |
| (s3)    | Start device where data is stored                          | —                            | Word           | ANY16*2                                 |
| (d2)    | Bit device that turns on upon completion of the processing | —                            | Bit            | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                        | —                            | Bit            | BOOL                                    |
| ENO     | Execution result                                           | —                            | Bit            | BOOL                                    |

\*1 Only drive 2 (for the SD memory card) can be set.

\*2 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | —                                | —   | —                                     | —           | — | —           | —  | —                      | —        | — | —  | ○          |
| (s1)    | ○                                | —   | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —          |
| (d1)    | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —          |
| (s2)    | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —          |
| (s3)    | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —          |
| (d2)    | ○                                | —   | ○                                     | —           | — | —           | —  | —                      | —        | — | —  | —          |



## ■Control data (d1)

| Operand: (d1) |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                 |        |
|---------------|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------|
| Device        | Item                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Setting range                                                                                   | Set by |
| +0            | Execution/completion type       | Specify the execution type.<br>■00**H: Writing binary data<br>• 0000H: 16-bit binary data<br>• 0001H: 32-bit binary data<br>■01**H: Writing data after converted to CSV format<br>• 0100H: Decimal (signed 16-bit data)<br>• 0101H: Decimal (unsigned 16-bit data)<br>• 0110H: Decimal (signed 32-bit data)<br>• 0111H: Decimal (unsigned 32-bit data)<br>• 0120H: Hexadecimal (16-bit data)<br>• 0121H: Hexadecimal (32-bit data)<br>• 0130H: String (ASCII data)<br>• 0140H: Floating point real number (single-precision real number)<br>• 0141H: Floating point real number (double-precision real number) | 0000H<br>0001H<br>0100H<br>0101H<br>0110H<br>0111H<br>0120H<br>0121H<br>0130H<br>0140H<br>0141H | User   |
| +1            | Completion status               | The completion status is stored upon completion of the instruction.<br>• 0000H: Completed successfully<br>• Other than 0000H: Completed with an error (error code) (📄 Page 663 Error codes generated for file operation instructions)                                                                                                                                                                                                                                                                                                                                                                          | —                                                                                               | System |
| +2            | Number of data actually written | For the data in the device specified by (s3), the number of data actually written is stored.<br>The data unit is determined by (d1)+7 (Data type specification).                                                                                                                                                                                                                                                                                                                                                                                                                                               | —                                                                                               | System |
| +3            | Application setting area        | <div> <div>b15</div> <div>...</div> <div>b0</div> <div>0</div> <div>1/0</div> </div> b0: Write start position setting*3<br>When "Writing binary data" is specified by (d1)+0, set 0.<br>When "Converting and writing data in CSV format" is specified by (d1)+0, and when "Added to the end of the file" is specified by (d1)+4 and (d1)+5, specify the write start position.<br>• 0: Added to the end of the file<br>• 1: Convert the return code at the end of the file to a comma and add it (write as continuation of the last line).                                                                      | Refer to the "Description" column.                                                              | User   |
| +4<br>+5      | File position                   | ■When "Writing binary data" is specified by (d1)+0<br>• 00000000H: From the beginning of the file<br>• 00000001H to FFFFFFFEH: From the specified position (The data unit is determined by (d1)+7.)<br>• FFFFFFFFH: Added to the end of the file.<br>■When "Converting and writing data in CSV format" is specified by (d1)+0<br>• 00000000H to FFFFFFFEH: From the beginning of the file<br>• FFFFFFFFH: Added to the end of the file.                                                                                                                                                                        | 00000000H to FFFFFFFFH                                                                          | User   |
| +6            | Number of columns               | When "Writing binary data" is specified by (d1)+0, set 0.<br>When "Converting and writing data in CSV format" is specified by (d1)+0, specify the number of columns to write.<br>• 0: No column (Regarded as one row.)<br>• Other than 0: Number of specified columns                                                                                                                                                                                                                                                                                                                                          | 0000H to FFFFH<br>(0 to 65535)                                                                  | User   |
| +7            | Data type specification         | • 0: Word<br>• 1: Even number of bytes*1<br>• 2: Unit of the data type specified by (d1)+0<br>• 3: Odd number of bytes*1*2<br>"0: Word", "1: Even number of bytes", and "3: Odd number of bytes" can be specified only when "0000H: 16-bit binary data" or "0100H: Decimal (signed 16-bit data)" is specified by (d1)+0.                                                                                                                                                                                                                                                                                       | 0, 1, 2, 3                                                                                      | User   |

\*1 When "1: Even number of bytes" or "3: Odd number of bytes" is specified by (d1)+7 (Data type specification), the setting range of (s3)+0 (Number of request write data) is 1 to 32767.

\*2 Even when "3: Odd number of bytes" is specified by (d1)+7 (Data type specification), specify the number in units of words. Add one byte to the odd number of bytes to be written and set the number in (s3)+0 (Number of request write data).

\*3 Enabled only when "Converting and writing data in CSV format" is specified by (d1)+0 (Execution/completion type), and when "Added to the end of the file" is specified by (d1)+4 and (d1)+5 (File position). Otherwise, an error will occur.

## ■File name (s2)

| Operand: (s2) |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |        |
|---------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|
| Device        | Item             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Setting range  | Set by |
| +0 to +□      | File name string | <p>Specify the folder path where the files are stored and the file name.</p> <ul style="list-style-type: none"> <li>The folder path and file name (including an extension) must be within 253 characters in total.</li> <li>The folder path must be within 244 characters. (Delimiters are not included.)</li> <li>The number of folder path hierarchies must be within 10 levels.</li> <li>When omitting an extension in the file name, omit the "." (period)" as well.</li> <li>The file name (not including the extension) must be between 1 and 60 characters, and the extension must be within a period + 3 characters. If the file name (not including the extension) is 61 characters or more, the extension is ignored and replaced with ".BIN" or ".CSV".</li> </ul> <div style="text-align: center;"> <p>"/folder1/user1/user1.csv"</p> <p>(1) (2) (3)</p> </div> <p>(1) Up to 253 characters<br/> (2) Use "/" or "\" as delimiters for the folder path and file.<br/> (3) Can be omitted. When it is omitted, (1) is up to 252 characters.</p> | Unicode string | User   |

## ■Write data (s3)

| Operand: (s3) |                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |        |
|---------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|
| Device        | Item                         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Setting range  | Set by |
| +0            | Number of request write data | <p>Specify the number of data to be requested to write.</p> <p>The processing unit and setting range depend on the value set in (d1)+0.</p> <p>■When "Writing binary data" is specified by (d1)+0</p> <ul style="list-style-type: none"> <li>When 16-bit binary data is specified: In units of words (1 to 65535)*1*2</li> <li>When 32-bit binary data is specified: In units of double words (1 to 32767)</li> </ul> <p>■When "Converting and writing data in CSV format" is specified by (d1)+0: Number of elements</p> <ul style="list-style-type: none"> <li>When decimal (signed 16-bit data) is specified: In units of words (1 to 65535)*1*2</li> <li>When decimal (unsigned 16-bit data) is specified: In units of words (1 to 65535)</li> <li>When decimal (signed 32-bit data) is specified: In units of double words (1 to 32767)</li> <li>When decimal (unsigned 32-bit data) is specified: In units of double words (1 to 32767)</li> <li>When hexadecimal (16-bit data) is specified: In units of words (1 to 65535)</li> <li>When hexadecimal (32-bit data) is specified: In units of double words (1 to 32767)</li> <li>When a string (ASCII data) is specified: Number of elements (1 to 1023)</li> <li>When a floating point real number (single-precision real number) is specified: In units of double words (1 to 32767)</li> <li>When a floating point real number (double-precision real number) is specified: In units of 4 words (1 to 16383)</li> </ul> | 1 to 65535     | User   |
| +1 to +□      | Write data                   | The number of data to be requested to write is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0000H to FFFFH | User   |

\*1 When "1: Even number of bytes" or "3: Odd number of bytes" is specified by (d1)+7 (Data type specification), the setting range of (s3)+0 (Number of request write data) is 1 to 32767.

\*2 Even when "3: Odd number of bytes" is specified by (d1)+7 (Data type specification), specify the number in units of words. Add one byte to the odd number of bytes to be written and set the number in (s3)+0 (Number of request write data).

## Processing details

- This instruction writes the specified number of data to the specified file. Set the execution/completion type in the control data to specify the file write-target format.
- The write target is the SD memory card only.
- The processing completion bit device (d2) automatically turns on at the execution of the END instruction in the scan in which the completion of processing of the SP.FWRITE instruction is detected. The bit device (d2) turns off at the execution of the END instruction in the next scan.
- If the SP.FWRITE instruction completes with an error, the error completion device (d2)+1 turns on or off in synchronization with (d2).
- SM753 (File being accessed) turns on while the SP.FWRITE instruction is being executed.
- While SM753 is on, the SP.FWRITE instruction cannot be executed. (If the instruction is executed, no processing is performed.)
- Even if an error is detected during the execution of the instruction, the bit devices (d2) and (d2)+1 and SM753 do not turn on.
- Specify data in (s3)+0, (d1)+4, (d1)+5, and (d1)+2 depending on the combination of (d1)+0 and (d1)+7.

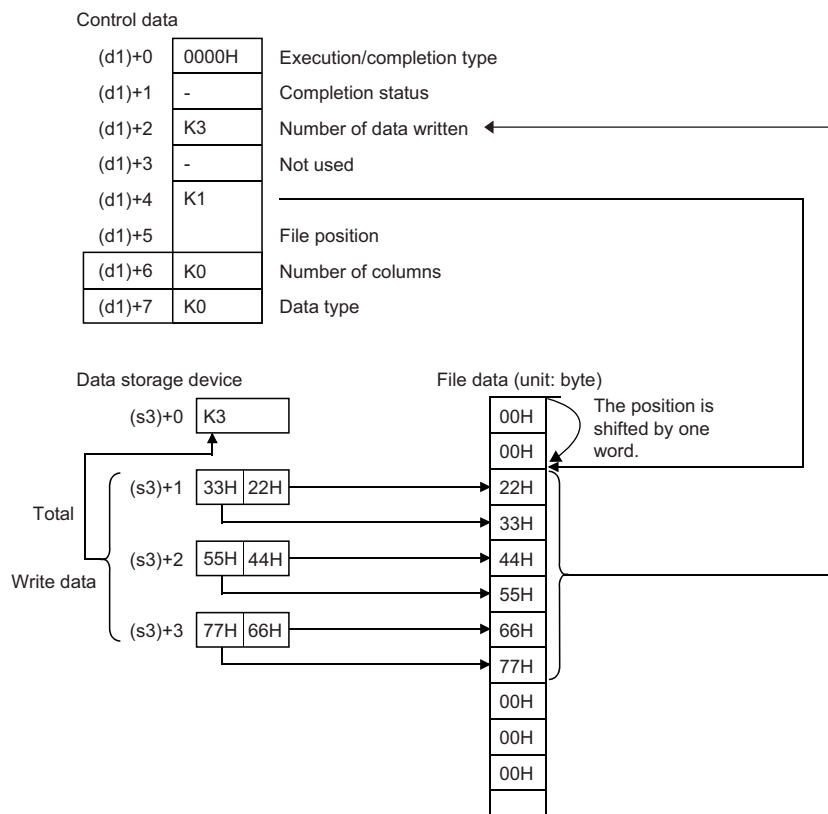
| Execution/completion type<br>(d1)+0                    |                                       | Data type<br>specification<br>(d1)+7                                | Processing unit and setting range         |                                                 |                                              |
|--------------------------------------------------------|---------------------------------------|---------------------------------------------------------------------|-------------------------------------------|-------------------------------------------------|----------------------------------------------|
|                                                        |                                       |                                                                     | Number of request<br>write data<br>(s3)+0 | File position<br>(d1)+4, (d1)+5                 | Number of data<br>actually written<br>(d1)+2 |
| Writing<br>binary<br>data                              | 0000H: 16-bit binary data             | 0: Word                                                             | Word (1 to 65535)                         | Word (00000000H to 7FFFFFFFH, FFFFFFFFH)        | Word                                         |
|                                                        |                                       | 1: Even number of bytes                                             | Word (1 to 32767)                         | Byte (00000000H to FFFFFFFFH)                   | Byte                                         |
|                                                        |                                       | 2: Unit of the data type specified by the execution/completion type | Word (1 to 65535)                         | Word (00000000H to 7FFFFFFFH, FFFFFFFFH)        | Word                                         |
|                                                        |                                       | 3: Odd number of bytes                                              | Word (1 to 32767)                         | Byte (00000000H to FFFFFFFFH)                   | Byte                                         |
|                                                        | 0001H: 32-bit binary data             | 0: Word<br>1: Even number of bytes                                  | (Cannot be specified)                     |                                                 |                                              |
|                                                        |                                       | 2: Unit of the data type specified by the execution/completion type | Double word (1 to 32767)                  | Double word (00000000H to 3FFFFFFFH, FFFFFFFFH) | Double word                                  |
|                                                        |                                       | 3: Odd number of bytes                                              | (Cannot be specified)                     |                                                 |                                              |
| Writing<br>data after<br>converted<br>to CSV<br>format | 0100H: Decimal (signed 16-bit data)   | 0: Word                                                             | Word (1 to 65535)                         | Head/end <sup>*3</sup>                          | Word                                         |
|                                                        |                                       | 1: Even number of bytes                                             | Word (1 to 32767)                         | Head/end <sup>*3</sup>                          | Byte                                         |
|                                                        |                                       | 2: Unit of the data type specified by the execution/completion type | Word (1 to 65535)                         | Head/end <sup>*3</sup>                          | Word                                         |
|                                                        |                                       | 3: Odd number of bytes                                              | Word (1 to 32767)                         | Head/end <sup>*3</sup>                          | Byte                                         |
|                                                        | 0101H: Decimal (unsigned 16-bit data) | 0: Word<br>1: Even number of bytes                                  | (Cannot be specified)                     |                                                 |                                              |
|                                                        |                                       | 2: Unit of the data type specified by the execution/completion type | Word (1 to 65535)                         | Head/end <sup>*3</sup>                          | Word                                         |
|                                                        |                                       | 3: Odd number of bytes                                              | (Cannot be specified)                     |                                                 |                                              |

| Execution/completion type<br>(d1)+0                    |                                                                  | Data type<br>specification<br>(d1)+7                                         | Processing unit and setting range         |                                 |                                              |
|--------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------|---------------------------------|----------------------------------------------|
|                                                        |                                                                  |                                                                              | Number of request<br>write data<br>(s3)+0 | File position<br>(d1)+4, (d1)+5 | Number of data<br>actually written<br>(d1)+2 |
| Writing<br>data after<br>converted<br>to CSV<br>format | 0110H: Decimal (signed 32-bit data)                              | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                     |                                 |                                              |
|                                                        |                                                                  | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Double word (1 to 32767)                  | Head/end <sup>*3</sup>          | Double word                                  |
|                                                        |                                                                  | 3: Odd number of bytes                                                       | (Cannot be specified)                     |                                 |                                              |
|                                                        | 0111H: Decimal (unsigned 32-bit data)                            | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                     |                                 |                                              |
|                                                        |                                                                  | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Double word (1 to 32767)                  | Head/end <sup>*3</sup>          | Double word                                  |
|                                                        |                                                                  | 3: Odd number of bytes                                                       | (Cannot be specified)                     |                                 |                                              |
|                                                        | 0120H: Hexadecimal (16-bit data)                                 | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                     |                                 |                                              |
|                                                        |                                                                  | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Word (1 to 65535)                         | Head/end <sup>*3</sup>          | Word                                         |
|                                                        |                                                                  | 3: Odd number of bytes                                                       | (Cannot be specified)                     |                                 |                                              |
|                                                        | 0121H: Hexadecimal (32-bit data)                                 | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                     |                                 |                                              |
|                                                        |                                                                  | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Double word (1 to 32767)                  | Head/end <sup>*3</sup>          | Double word                                  |
|                                                        |                                                                  | 3: Odd number of bytes                                                       | (Cannot be specified)                     |                                 |                                              |
|                                                        | 0130H: String (ASCII data)                                       | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                     |                                 |                                              |
|                                                        |                                                                  | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Number of elements (1 to 1023)            | Head/end <sup>*3</sup>          | Number of elements                           |
|                                                        |                                                                  | 3: Odd number of bytes                                                       | (Cannot be specified)                     |                                 |                                              |
|                                                        | 0140H: Floating point real number (single-precision real number) | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                     |                                 |                                              |
|                                                        |                                                                  | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | Double word (1 to 32767)                  | Head/end <sup>*3</sup>          | Double word                                  |
|                                                        |                                                                  | 3: Odd number of bytes                                                       | (Cannot be specified)                     |                                 |                                              |
|                                                        | 0141H: Floating point real number (double-precision real number) | 0: Word<br>1: Even number of bytes                                           | (Cannot be specified)                     |                                 |                                              |
|                                                        |                                                                  | 2: Unit of the data type<br>specified by the<br>execution/completion<br>type | 4 words (1 to 16383)                      | Head/end <sup>*3</sup>          | 4 words                                      |
|                                                        |                                                                  | 3: Odd number of bytes                                                       | (Cannot be specified)                     |                                 |                                              |

\*3 The set value is from 00000000H to FFFFFFFEH (from the beginning of the file) or FFFFFFFFH (added to the end of the file).

## ■Writing binary data

- If the extension of the target file is omitted, the extension will be ".BIN".
- If a file that does not exist is specified, it will be created and data will be saved to the beginning of the file. The newly created file has the archive attribute.
- When an existing file is specified, data will be saved to the beginning of the file. If the size of data exceeds the size of the existing area in the file during writing, the excess data is additionally stored.
- If the specified position exceeds the existing file size, 0 point of data is written and the processing completes successfully.
- If the media runs out of free space during additional saving of data, an error occurs. In this case, the data already added and saved successfully is held as is and as much remaining data as possible is added and saved before termination with an error.
- In 16-bit binary data write mode, when the number of request write data and file position are specified, data is written as follows.

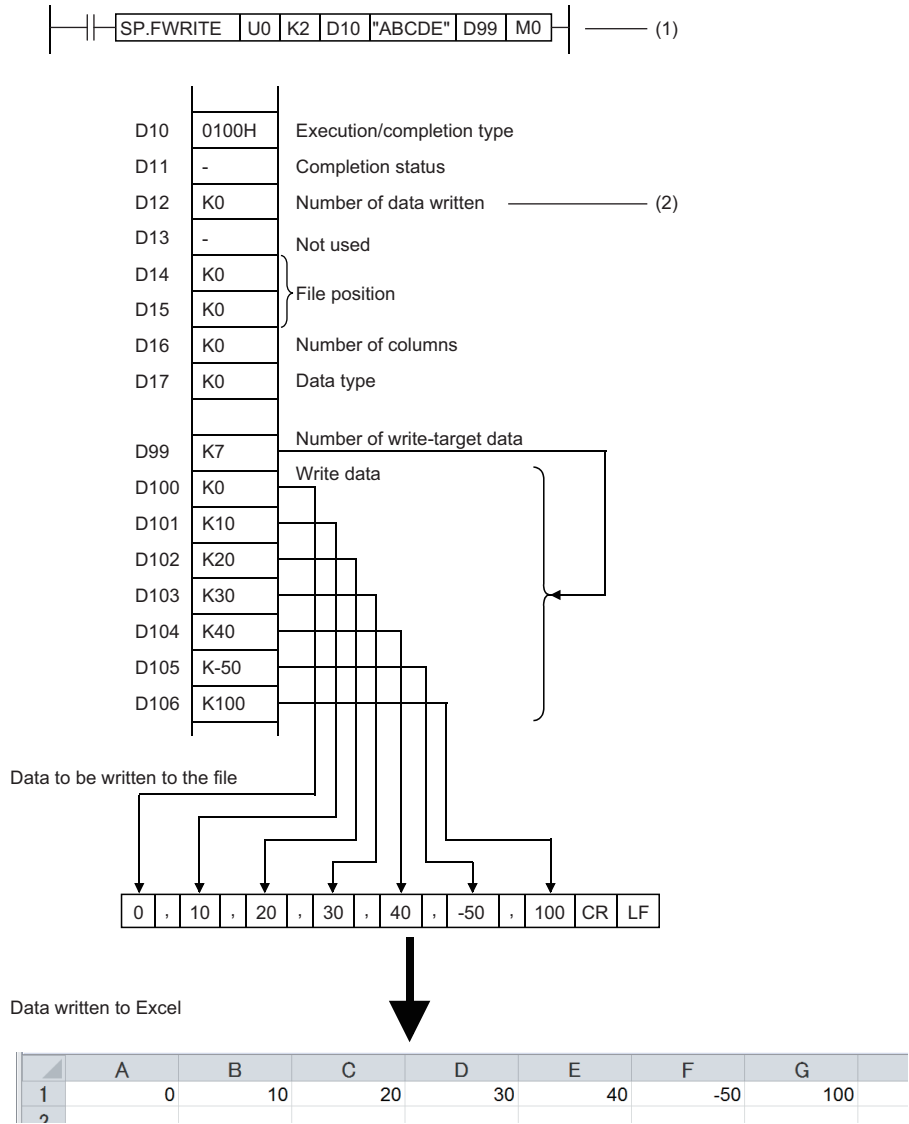


■Converting and writing data in CSV format

- If the extension is omitted, the extension will be ".CSV".
- When an existing file is specified, the following occurs.
  - When a value specified by (d1)+4 and (d1)+5 is other than FFFFFFFFH, data is saved to the file after deleting all the existing data in the file.
  - When a value specified by (d1)+4 and (d1)+5 is FFFFFFFFH, data is added and saved to the end of the file. If 1 is specified in (d1)+3, the return code at the end of the file will be converted to a comma and the data will be saved. However, if the end of the file is something other than a return code, the data will be saved from the end of the file without conversion to a comma.
- If a file that does not exist is specified, it will be created and data will be saved to the beginning of the file. The newly created file has the archive attribute.
- If the media runs out of free space during additional saving of data, an error occurs. In this case, the data already added and saved successfully is held as is and as much remaining data as possible is added and saved before termination with an error.
- When the number of columns is set to 0, data is read as a single-row data in a CSV format file.

Ex.

The number of columns is set to 0 when writing data after conversion to the CSV format.

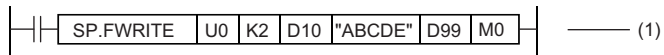
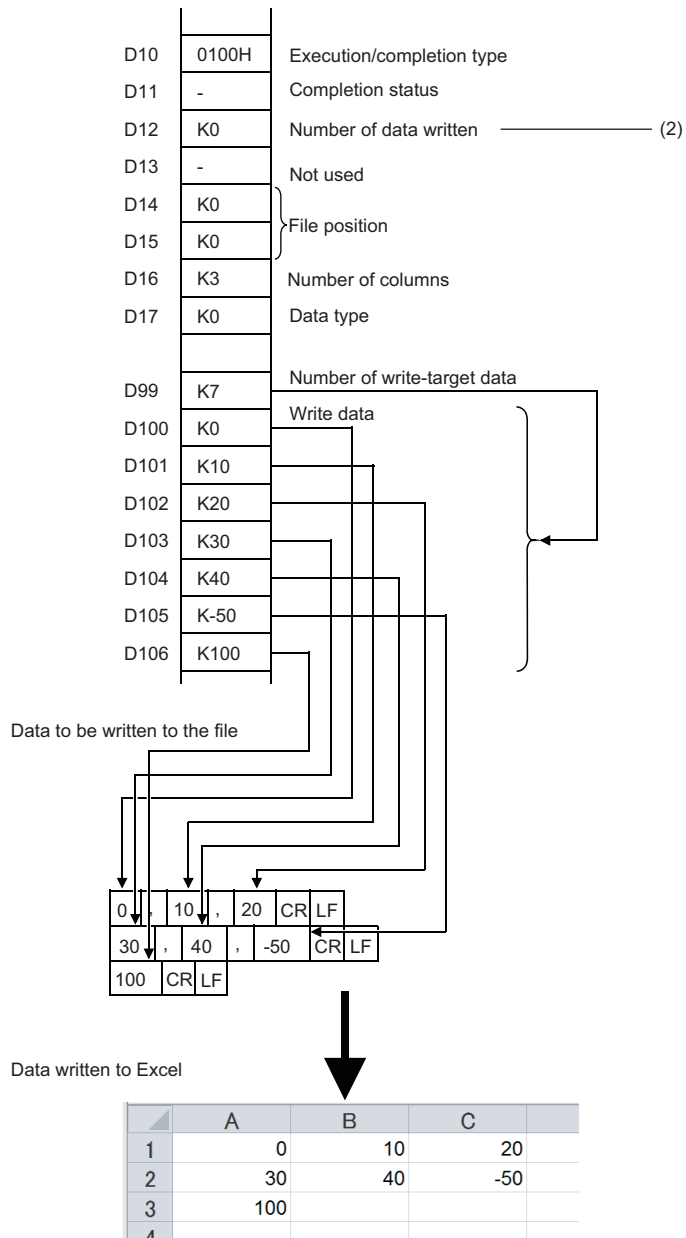


(1) Specified in units of words  
(2) Same as the number of write data if case of normal completion

- When the specified number of columns is set to a value other than 0, a CSV format file is stored as the table with the specified number of columns.

**Ex.**

The number of columns is set to a value other than 0 when writing data after conversion to the CSV format.



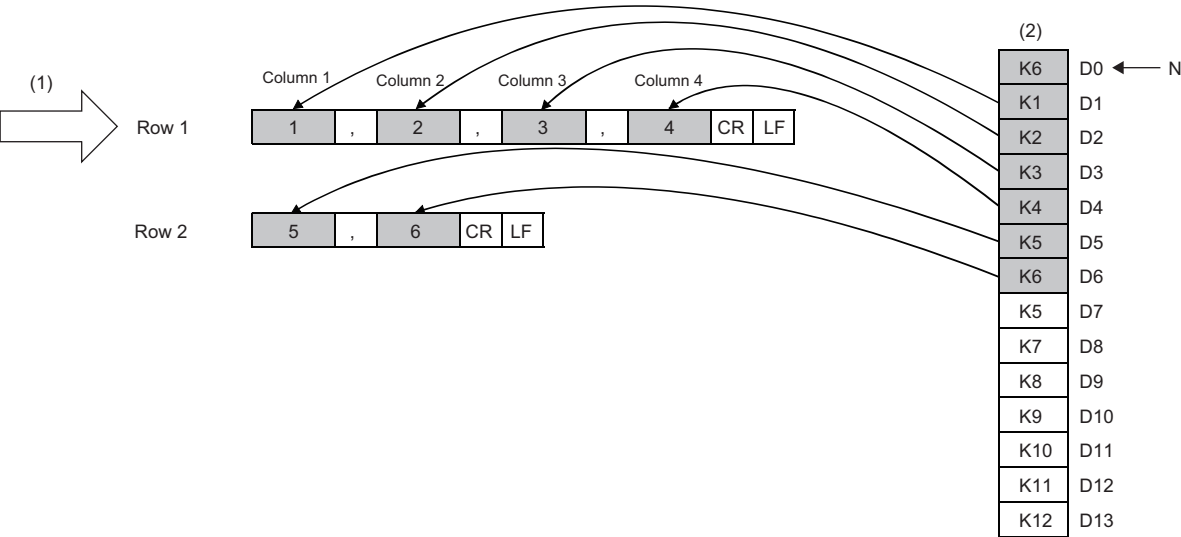
(1) Specified in units of words

(2) Same as the number of write data if case of normal completion

- The following figure shows how data is added.

[Specify the file to which data will be written.] (Even if the file exists, it is deleted and re-created.)

- Execution/completion type: Writing data after converted to CSV format (Decimal (signed 16-bit data))
- File position: 00000000H (from the beginning of the file)
- Number of columns specification: 4H
- Data type specification: Words
- Write start device: D0
- Number of request write data: 6H

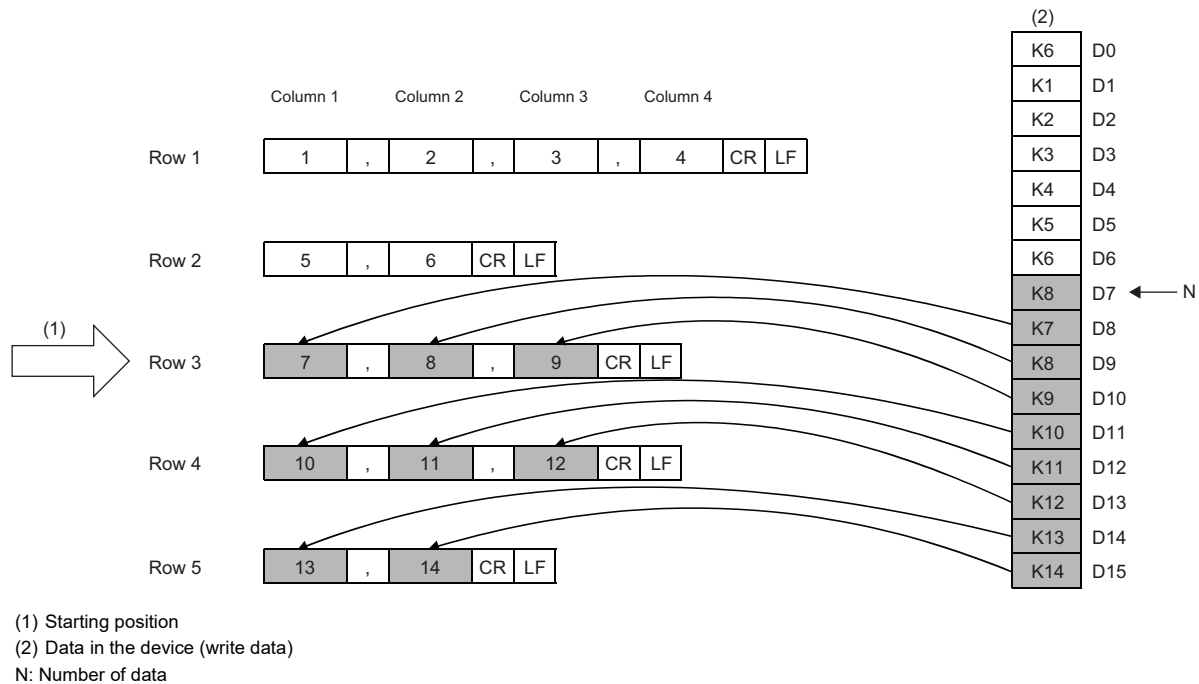


- (1) Starting row  
 (2) Data in the device (write data)  
 N: Number of data



[Added to the end of the file]

- Execution/completion type: Writing data after converted to CSV format (Decimal (signed 16-bit data))
- Application setting area: 0H
- File position: FFFFFFFFH (added to the end of the file)
- Number of columns specification: 3H
- Data type specification: Words
- Write start device: D7
- Number of request write data: 8H

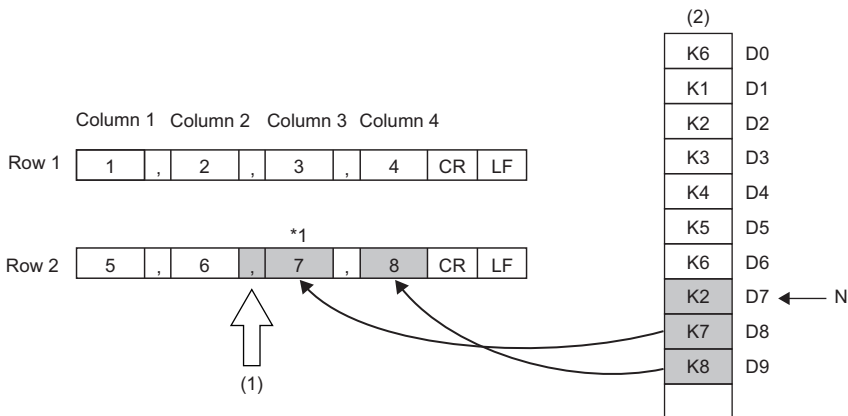


**Point**

- An integral multiple of "Number of columns" should be specified for "Number of request write data". Otherwise, numbers of columns will be apart.
- The last data is always followed by a return code, so if the application setting area is 0, data is added starting from the beginning of a new line.
- When data is added to the end of a file, columns are shifted if "Number of columns" is changed from the previous writing.

[Added from the last line of the file]

- Execution/completion type: Writing data after converted to CSV format (Decimal (signed 16-bit data))
- Application setting area: 1H
- File position: FFFFFFFFH (added to the end of the file)
- Data type specification: Words
- Write start device: D7
- Number of request write data: 2H



(1) Starting position  
(2) Data in the device (write data)  
N: Number of data

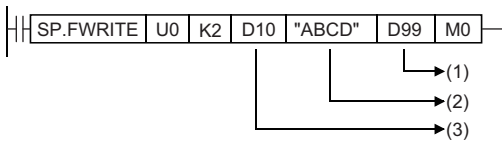
\*1 If 1 is set in the application setting area, the return code at the end of the file will be converted to a comma, and data can be added from the last line.

- The following figures show an example of specifying "String (ASCII data)" for the execution/completion type.

**Ex.**

Writing data after converted to CSV format (string (ASCII data))

[Data to be written to a file]

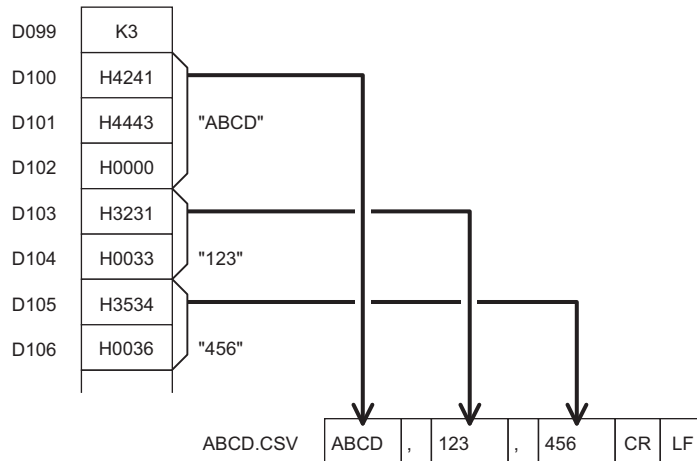


- (1) Data to be written  
(2) File name  
(3) Control data

[Control data]

|     |       |
|-----|-------|
| D10 | H0130 |
| D11 | H0000 |
| D12 | -     |
| D13 | -     |
| D14 | K0    |
| D15 | K0    |
| D16 | K0    |
| D17 | K2    |

- D10: Execution/completion type: String (ASCII data)  
D11: Completion status  
D12: Number of data actually written  
D13: (Not used)  
D14, D15: File position  
D16: Number of columns  
D17: Data type specification



- D99: Number of request write data  
D100 to D102: String to be written to the 1st column of the 1st line  
D103, D104: String to be written to the 2nd column of the 1st line  
D105, D106: String to be written to the 3rd column of the 1st line

|   | A    | B   | C   | D |
|---|------|-----|-----|---|
| 1 | ABCD | 123 | 456 |   |
| 2 |      |     |     |   |

**Point**

- Set 00H (NULL) in the end of the string in an element. When the number of bytes of the string is even, set 0000H (two bytes of NULL) in the next one word.
- The maximum number of characters in one element is 1999. If this maximum number is exceeded and 00H (NULL) is not stored, characters of 2000th character and after are not written and the write processing shifts to the next element.
- A maximum of 1023 elements can be written in a single instruction execution.

- The following table lists values to set in (s3)+1 and later and data to be written in a CSV file when "0140H: Floating point real number (single-precision real number)" or "0141H: Floating point real number (double-precision real number)" is set to (d1)+0.

| Execution/completion type ((d1)+0)                               | Value to set in the write data ((s3)+1 and later)                                                                        | Data to be written in a CSV file                                                                    |
|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| 0140H: Floating point real number (single-precision real number) | Values within the range of: $-2^{128} < \text{data} \leq -2^{-126}$ ,<br>0,<br>$2^{-126} \leq \text{data} < 2^{128}$     | A value (0 to 7 digits in the decimal part) as given on the left is written in exponential format.  |
|                                                                  | Values other than above                                                                                                  | 0 is written. (Data cannot be converted.)                                                           |
| 0141H: Floating point real number (double-precision real number) | Values within the range of: $-2^{1024} < \text{data} \leq -2^{-1022}$ ,<br>0,<br>$2^{-1022} \leq \text{data} < 2^{1024}$ | A value (0 to 15 digits in the decimal part) as given on the left is written in exponential format. |
|                                                                  | Values other than above                                                                                                  | 0 is written. (Data cannot be converted.)                                                           |

- The following shows how the file size (total number of bytes) is calculated when a CSV format file is written to the SD memory card.

[Total number of bytes] = [Total number of bytes excluding the last row] + [Number of bytes of the last row]

([Number of bytes of each row] = [Number of columns<sup>\*2</sup>] + 1 + [total number of bytes of all data values per line]<sup>\*3</sup>)

- \*2 The specified number of columns applies to rows other than the last row. The number of columns of the last row is calculated as shown below because it may differ from the specified number of rows depending on the number of write data.

- The number of rows excluding the last row is calculated. (Number of rows excluding the last row = number of requested write data - number of columns (remainders rounded down))
- The number of columns of the last row is calculated. (Number of columns of the last row = number of requested write data - (number of rows excluding the last row × number of columns))

- \*3 The following shows how the number of bytes of each data value is calculated.

| Sign of data value | Number of bytes of each data value | Range of bytes                                             | Example                             |
|--------------------|------------------------------------|------------------------------------------------------------|-------------------------------------|
| Positive           | Number of digits                   | 1 to 5 (word specification)<br>1 to 3 (byte specification) | • 12345: 5 bytes<br>• 67: 2 bytes   |
| Negative           | Number of digits + 1               | 2 to 6 (word specification)<br>2 to 4 (byte specification) | • -12345: 6 bytes<br>• -67: 3 bytes |

## Precautions

- Do not execute the SP.FWRITE instruction in interrupt programs. Doing so may cause malfunction of the module.
- Since the SP.FWRITE instruction causes file write, the scan time may be extended when this instruction is executed.
- The SP.FWRITE instruction does not support character codes with BOM. To write to a CSV file with BOM that was created using Excel, use an application such as a text editor to change the character code to exclude BOM.

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | The value specified by the number of request write data (s3)+0 is out of the range, or it exceeds the assignment range specified by (s3)+1 and later in the relevant device/label.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 3285H            | <p>The drive specified by (s1) is not the one for the SD memory card.</p> <p>Any value that is set in the device specified by (d1) and later as control data is out of the range.<br/>  Page 631 Control data (d1)</p> <p>The file name string specified by (s2) cannot be read.</p> <ul style="list-style-type: none"> <li>• The number of characters of the string in the file name specified exceeds the range.</li> <li>• An inhibited value is set.</li> <li>• The specified file name string ends with a delimiter.</li> <li>• The file name (not including the extension) of the specified file name string is 0 characters.</li> </ul> <p> Page 631 Control data (d1)</p> |
| 3297H            | <p>An invalid combination of (d1)+0 (Execution/completion type) and (d1)+7 (Data type specification) is specified.</p> <p>An invalid combination of (d1) (Execution/completion type), (d1)+3 (Write start position setting), and (d1)+4 (File position specification) is specified.</p> <p> Page 631 Control data (d1)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                         |

If the SP.FWRITE instruction completes with an error, an error code is stored in the device specified by (d1)+1. (Note that an error code is not stored if the instruction results in an operation error.)

For the error code stored in (d1)+1, refer to the following.

 Page 663 Error codes generated for file operation instructions

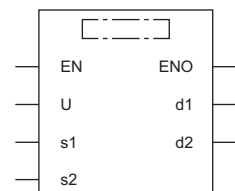
# Deleting the specified file

## SP.FDELETE

This instruction deletes the specified file or folder in an SD memory card.

| Ladder | ST                                 |
|--------|------------------------------------|
|        | ENO:=SP_FDELETE(EN,U,s1,s2,d1,d2); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SP.FDELETE  |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                | Range                      | Data type      | Data type (label)                       |
|---------|------------------------------------------------------------|----------------------------|----------------|-----------------------------------------|
| (U)     | Dummy                                                      | —                          | Device name    | ANY16                                   |
| (s1)    | Drive specification                                        | 2 (fixed)*1                | Word           | ANY16                                   |
| (d1)    | Start device where the control data is stored              | Page 645 Control data (d1) | Word           | ANY16_ARRAY<br>(Number of elements: 2)  |
| (s2)    | Start device where the file name or folder name is stored  | —                          | Unicode string | ANYSTRING_DOUBLE                        |
| (d2)    | Bit device that turns on upon completion of the processing | —                          | Bit            | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                        | —                          | Bit            | BOOL                                    |
| ENO     | Execution result                                           | —                          | Bit            | BOOL                                    |

\*1 Only drive 2 (for the SD memory card) can be set.

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | —                                | —   | —                                     | —          | — | —           | —  | —                      | —        | — | —  | ○          |
| (s1)    | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —          |
| (d1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —          |
| (d2)    | ○                                | —   | ○                                     | —          | — | —           | —  | —                      | —        | — | —  | —          |

## ■Control data (d1)

| Operand: (d1) |                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                    |        |
|---------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------|
| Device        | Item                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Setting range                      | Set by |
| +0            | Application setting area | <div> <div> <div>b15</div> <div>...</div> <div>b1</div> <div>b0</div> </div> <div> <div>0</div> <div>1/0</div> <div>1/0</div> </div> </div> <p>b0: Target type setting<br/>Specify the type of data (file or folder) to delete.</p> <ul style="list-style-type: none"> <li>• 0: File</li> <li>• 1: Folder</li> </ul> <p>b1: Empty folder deletion setting<br/>Specify whether to delete only empty folders when deleting folders.</p> <ul style="list-style-type: none"> <li>• 0: Delete the folder even when it contains data.</li> <li>• 1: Delete the folder only when it is empty.</li> </ul> | Refer to the "Description" column. | User   |
| +1            | Completion status        | <p>The completion status is stored upon completion of the instruction.</p> <ul style="list-style-type: none"> <li>• 0000H: Completed successfully</li> <li>• Other than 0000H: Completed with an error (error code) (  Page 663 Error codes generated for file operation instructions)</li> </ul>                                                                                                                                                                                                                | —                                  | System |

## ■File name/folder name (s2)

| Operand: (s2) |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |        |
|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|
| Device        | Item                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Setting range  | Set by |
| +0 to +□      | File name/folder name | <p>When specifying a file, specify the folder path where the file to be deleted is stored and the file name.</p> <p>When specifying a folder, specify the folder path of the folder to be deleted.</p> <ul style="list-style-type: none"> <li>• If the file name has an extension, do not omit it.</li> <li>• The file name, including the period and extension, must be within 64 characters.</li> <li>• The folder path and file name (including the period and extension) must be within 253 characters in total.</li> <li>• The folder path must be within 244 characters. (Delimiters are not included.)</li> <li>• Specify one character or more for the file name or folder path in addition to a delimiter.</li> <li>• When specifying a file, do not add a delimiter at the end of a string.</li> <li>• Do not put a period (one-byte) at the end of a string or directly before each delimiter.</li> <li>• The number of folder path hierarchies must be within 10 levels.</li> </ul> <p>■When a file is specified</p> <div> <div>(1)</div> <div>" / folder1 / user1 / user1.csv "</div> <div>(3)</div> <div>(2)</div> </div> <p>(1) Up to 253 characters<br/>(2) Use "/" or "\" as delimiters for the folder path and file.<br/>(3) Can be omitted. When it is omitted, (1) is up to 252 characters.</p> <p>■When a folder is specified</p> <div> <div>(4)</div> <div>" / folder1 / user1 / subfolder1 / "</div> <div>(6)</div> <div>(5)</div> <div>(7)</div> </div> <p>(4) Up to 244 characters<br/>(5) Use "/" or "\" as delimiters for the folder path.<br/>(6) Can be omitted. When it is omitted, (4) is up to 243 characters.<br/>(7) Can be omitted.</p> | Unicode string | User   |

## Processing details

- This instruction deletes the file or folder specified by (s2) in the drive specified by (s1).
- SM753 (File being accessed) turns on while the SP.FDELETE instruction is being executed. While SM753 is on, the SP.FDELETE instruction cannot be executed. (If the instruction is executed, no processing is performed.)
- The processing completion bit device (d2) automatically turns on at the execution of the END instruction in the scan in which the completion of processing of the SP.FDELETE instruction is detected. The bit device (d2) turns off at the execution of the END instruction in the next scan.
- If the SP.FDELETE instruction completes with an error, the error completion device (d2)+1 turns on or off in synchronization with (d2).
- If an operation error is detected during the execution of the instruction, (d2) and (d2)+1 do not turn on.

## Precautions

- Do not execute the SP.FDELETE instruction in interrupt programs. Doing so may cause malfunction of the module.
- Even though the operating status of the controller is switched from RUN to STOP during instruction execution, the controller continues the processing of the instruction.
- If the instruction is completed with an error during processing, the file or folder already deleted is not restored.
- When the size of a file to be deleted or the number of files to be deleted becomes larger, the instruction will take more time to complete.
- Do not access the file being processed by the SP.FDELETE instruction from other functions. (The file may be corrupt or an error may occur.)
- Do not operate files or folders being accessed from other functions.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | The drive specified by (s1) is not the one for the SD memory card.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                  | The file name/folder name string specified by (s2) cannot be read. <ul style="list-style-type: none"><li>• The specified file name string contains no character.</li><li>• The specified file name string contains 254 characters or more.</li><li>• The specified folder path contains 245 characters or more.</li><li>• The specified folder path hierarchies contains 11 levels or more.</li><li>• The specified file name string has a period (one-byte) at its end or directly before each delimiter.</li><li>• When a file is specified, the file name string ends with a delimiter.</li></ul> |
|                  | A system folder (\$MELPRJ\$) which is directly under the root folder is in the folder path specified by (s2).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

If the SP.FDELETE instruction completes with an error, an error code is stored in the device specified by (d1)+1. (Note that an error code is not stored if the instruction results in an operation error.)

For the error code stored in (d1)+1, refer to the following.

 Page 663 Error codes generated for file operation instructions



## Copying the specified file

### SP.FCOPY

This instruction copies the specified file or folder in an SD memory card. When a folder is specified, the specified folder is copied in its entirety, or all the files and subfolders in the specified folder are copied.

| Ladder | ST                                     |
|--------|----------------------------------------|
|        | ENO:=SP_FCOPY(EN,U,s1,s2,s3,s4,d1,d2); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SP.FCOPY    |                     |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                                                  | Range                      | Data type      | Data type (label)                       |
|---------|------------------------------------------------------------------------------|----------------------------|----------------|-----------------------------------------|
| (U)     | Dummy                                                                        | —                          | Device name    | ANY16                                   |
| (d1)    | Start device where the control data is stored                                | Page 648 Control data (d1) | Word           | ANY16_ARRAY<br>(Number of elements: 2)  |
| (s1)    | Copy source drive                                                            | 2 (fixed)*1                | Word           | ANY16                                   |
| (s2)    | Start device where the file name or folder name of the copy source is stored | —                          | Unicode string | ANYSTRING_DOUBLE                        |
| (s3)    | Copy destination drive                                                       | 2 (fixed)*1                | Word           | ANY16                                   |
| (s4)    | Start device for storing the copy destination folder path                    | —                          | Unicode string | ANYSTRING_DOUBLE                        |
| (d2)    | Bit device that turns on upon completion of the processing                   | —                          | Bit            | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                          | —                          | Bit            | BOOL                                    |
| ENO     | Execution result                                                             | —                          | Bit            | BOOL                                    |

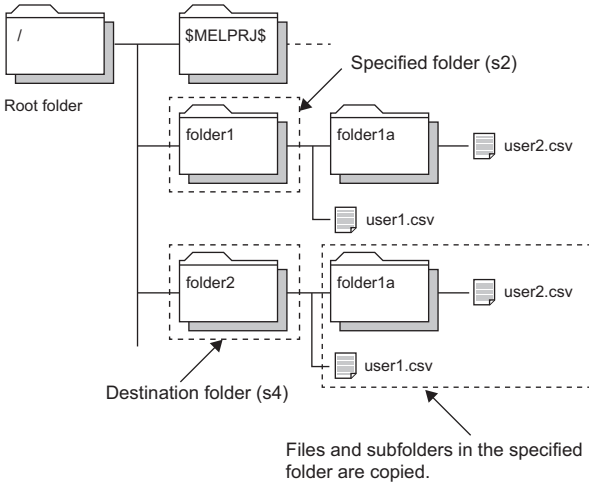
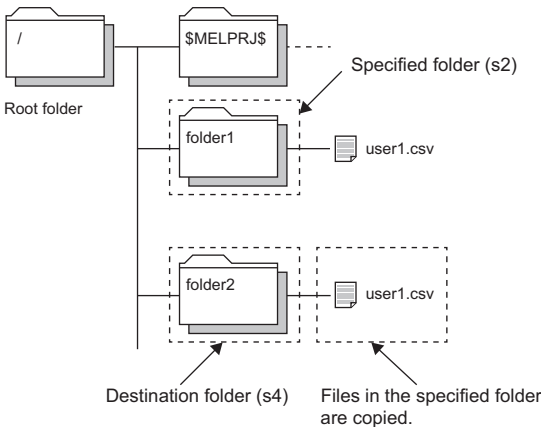
\*1 Only drive 2 (for the SD memory card) can be set.

## ■Applicable devices

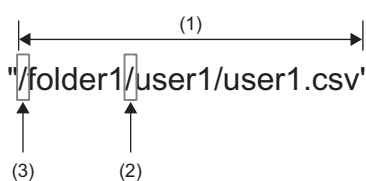
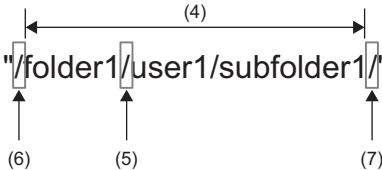
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | —                                | —   | —                                     | —          | — | —           | —  | —                      | —        | — | —  | ○          |
| (d1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |
| (s1)    | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —          |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —          |
| (s3)    | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —          |
| (s4)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —          |
| (d2)    | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |

## ■Control data (d1)

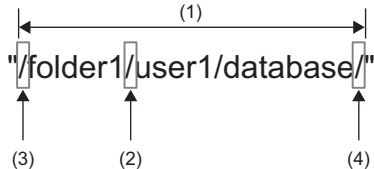
| Operand: (d1) |                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                    |        |
|---------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------|
| Device        | Item                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Setting range                      | Set by |
| +0            | Application setting area | <div> <div> <div>b15</div> <div>...</div> <div>0</div> </div> <div> <div>b2</div> <div>b1</div> <div>b0</div> <div>1/0</div> <div>1/0</div> <div>1/0</div> </div> </div> <p> <b>■b0, b2: Target type setting</b><br/> b0: Specify the type of data (file or folder) to copy.<br/> 0: File<br/> 1: Folder<br/> b2: Specify how the data is copied. (This bit is valid when b0 is set to 1 (Folder).)<br/> 0: Copy the folder in its entirety.<br/> 1: Copy all the files and subfolders in the folder.<br/> • Operation when b2 is set to 0 (Copy the folder in its entirety).<br/> The specified folder (including all files and subfolders in it) is copied in its entirety. </p> <p>The specified folder is copied in its entirety with its folder structure unchanged.</p> | Refer to the "Description" column. | User   |

| Operand: (d1) |                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                    |        |
|---------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------|
| Device        | Item                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Setting range                      | Set by |
| +0            | Application setting area | <p>• Operation when b2 is set to 1 (Copy all the files and subfolders in the folder), and the specified folder includes files and a subfolder<br/>All the files and subfolders in the specified folder are copied.</p>  <p>• Operation when b2 is set to 1 (Copy all the files and subfolders in the folder), and the specified folder includes only files (no subfolder)<br/>All the files in the specified folder are copied.</p>  <p>■b1: Overwrite setting<br/>Specify whether to overwrite a file or a folder if one with the same name as the copy source already exists in the copy destination.</p> <ul style="list-style-type: none"> <li>• 0: Do not overwrite the file or folder.</li> <li>• 1: Overwrite the file or folder.</li> </ul> <p>When b0 is set to 1 (Folder) or b1 is set to 0 (Do not overwrite the file or folder), the instruction skips copying a file or a folder having the same name with the one in the copy destination.<br/>(The instruction is completed and no error occurs.)</p> | Refer to the "Description" column. | User   |
| +1            | Completion status        | <p>The completion status is stored upon completion of the instruction.</p> <ul style="list-style-type: none"> <li>• 0000H: Completed successfully</li> <li>• Other than 0000H: Completed with an error (error code) (  Page 663 Error codes generated for file operation instructions)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | —                                  | System |

## ■Copy source file name/folder name (s2)

| Operand: (s2) |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |        |
|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|
| Device        | Item                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Setting range  | Set by |
| +0 to +□      | File name/folder name | <p>When specifying a file, specify the folder path where the copy source file is stored and the file name.</p> <p>When specifying a folder, specify the copy source folder path.</p> <ul style="list-style-type: none"> <li>• If the file name has an extension, do not omit it.</li> <li>• The file name, including the period and extension, must be within 64 characters.</li> <li>• The folder path and file name (including the period and extension) must be within 253 characters in total.</li> <li>• The folder path must be within 244 characters. (Delimiters are not included.)</li> <li>• Specify one character or more for the file name or folder path in addition to a delimiter.</li> <li>• When specifying a file, do not add a delimiter at the end of a string.</li> <li>• Do not put a period (one-byte) at the end of a string or directly before each delimiter.</li> <li>• The number of folder path hierarchies must be within 10 levels.</li> </ul> <p>■When a file is specified</p>  <p>(1) Up to 253 characters<br/> (2) Use "/" or "\" as delimiters for the folder path and file.<br/> (3) Can be omitted. When it is omitted, (1) is up to 252 characters.</p> <p>■When a folder is specified</p>  <p>(4) Up to 244 characters<br/> (5) Use "/" or "\" as delimiters for the folder path.<br/> (6) Can be omitted. When it is omitted, (4) is up to 243 characters.<br/> (7) Can be omitted.</p> | Unicode string | User   |

## ■Copy destination folder path (s4)

| Operand: (s4) |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |        |
|---------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|
| Device        | Item        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Setting range  | Set by |
| +0 to +□      | Folder path | <p>Specify the copy destination folder path.</p> <ul style="list-style-type: none"> <li>• The folder path must be within 244 characters. (Delimiters are not included.)</li> <li>• Specify one character or more for the folder path in addition to a delimiter.</li> <li>• Do not put a space (one-byte) at the end of a string or directly before each delimiter.</li> <li>• Do not put a period (one-byte) at the end of a string or directly before each delimiter.</li> <li>• The number of folder path hierarchies must be within 10 levels.</li> </ul>  <p>(1) Up to 244 characters<br/> (2) Use "/" or "\" as delimiters for the folder path.<br/> (3) Can be omitted. When it is omitted, (1) is up to 243 characters.<br/> (4) Can be omitted.</p> | Unicode string | User   |

## Processing details

- This instruction copies the file or folder specified by (s2) in the drive specified by (s1) to the folder specified by (s4) in the drive specified by (s3). When a folder is specified by (s2), a file and subfolder with the same names may exist in the copy destination. In this case, the instruction is not completed with an error even if the value of bit 1 (overwrite setting) of (d1) is 0. (Copying is skipped.)
- If the folder specified by (s4) does not exist in the copy destination, the folder is created automatically.
- SM753 (File being accessed) turns on while the SP.FCOPY instruction is being executed. While SM753 is on, the SP.FCOPY instruction cannot be executed. (If the instruction is executed, no processing is performed.)
- The processing completion bit device (d2) automatically turns on at the execution of the END instruction in the scan in which the completion of processing of the SP.FCOPY instruction is detected. The bit device (d2) turns off at the execution of the END instruction in the next scan.
- If the SP.FCOPY instruction completes with an error, the error completion device (d2)+1 turns on or off in synchronization with (d2).
- If an operation error is detected during the execution of the instruction, (d2) and (d2)+1 do not turn on.

## Precautions

- Do not execute the SP.FCOPY instruction in an interrupt program. Doing so may cause malfunction of the module.
- Even though the operating status of the controller is switched from RUN to STOP during instruction execution, the controller continues the processing of the instruction.
- Ensure that the number of characters in a folder path or in the total of a folder path and a file name after copying does not exceed its limit. (The file may be inaccessible or an error may occur.)
- If the instruction is completed with an error during processing, the file or folder may remain under processing.
- When the size of a file to be copied or the number of files to be copied becomes larger, the instruction will take more time to complete.
- Do not access the file being processed by the SP.FCOPY instruction from other functions. (The file may be corrupt or an error may occur.)
- Do not operate files or folders being accessed from other functions.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | <p>The drive specified by (s1) or (s3) is not the one for the SD memory card.</p> <hr/> <p>The file name/folder name string specified by (s2) cannot be read.</p> <ul style="list-style-type: none"> <li>• The specified file name string contains no character.</li> <li>• The specified file name string contains 254 characters or more.</li> <li>• The specified folder path contains 245 characters or more.</li> <li>• The specified folder path hierarchies contains 11 levels or more.</li> <li>• When a file is specified, the file name string ends with a delimiter.</li> <li>• The specified file name string has a period (one-byte) at its end or directly before each delimiter.</li> </ul> <hr/> <p>The folder path string specified by (s4) cannot be read.</p> <ul style="list-style-type: none"> <li>• The specified file path string contains no character.</li> <li>• The specified folder path string contains 245 characters or more.</li> <li>• The specified folder path hierarchies contains 11 levels or more.</li> <li>• The specified folder path string has a space (one-byte) at its end or directly before each delimiter.</li> <li>• The specified folder path string has a period (one-byte) at its end or directly before each delimiter.</li> </ul> <hr/> <p>A system folder (\$MELPRJ\$) which is directly under the root folder is in the folder path specified by (s2) or (s4).</p> |

If the SP.FCOPY instruction completes with an error, an error code is stored in the device specified by (d1)+1. (Note that an error code is not stored if the instruction results in an operation error.)

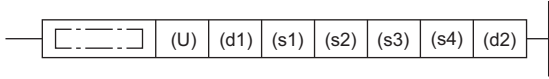
For the error code stored in (d1)+1, refer to the following.

 Page 663 Error codes generated for file operation instructions

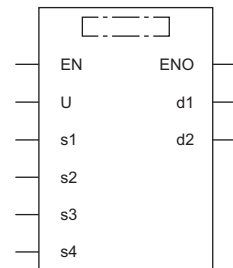
## Moving the specified file

### SP.FMOVE

This instruction moves the specified file or folder in an SD memory card. When a folder is specified, the specified folder is moved in its entirety, or all the files and subfolders in the specified folder are moved.

| Ladder                                                                            | ST                                     |
|-----------------------------------------------------------------------------------|----------------------------------------|
|  | ENO:=SP_FMOVE(EN,U,s1,s2,s3,s4,d1,d2); |

### FBD/LD



### Execution condition

| Instruction | Execution condition                                                                 |
|-------------|-------------------------------------------------------------------------------------|
| SP.FMOVE    |  |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                                       | Range                                                                                                          | Data type      | Data type (label)                       |
|---------|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------|
| (U)     | Dummy                                                             | —                                                                                                              | Device name    | ANY16                                   |
| (d1)    | Start device where the control data is stored                     |  Page 653 Control data (d1) | Word           | ANY16_ARRAY<br>(Number of elements: 2)  |
| (s1)    | Source drive                                                      | 2 (fixed)*1                                                                                                    | Word           | ANY16                                   |
| (s2)    | Start device where the file name or folder name to move is stored | —                                                                                                              | Unicode string | ANYSTRING_DOUBLE                        |
| (s3)    | Destination drive                                                 | 2 (fixed)*1                                                                                                    | Word           | ANY16                                   |
| (s4)    | Device for storing the destination folder path                    | —                                                                                                              | Unicode string | ANYSTRING_DOUBLE                        |
| (d2)    | Bit device that turns on upon completion of the processing        | —                                                                                                              | Bit            | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                               | —                                                                                                              | Bit            | BOOL                                    |
| ENO     | Execution result                                                  | —                                                                                                              | Bit            | BOOL                                    |

\*1 Only drive 2 (for the SD memory card) can be set.

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | —                                | —    | —                                     | —           | — | —           | —  | —                      | —        | — | —  | ○          |
| (d1)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —          |
| (s1)    | ○                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —          |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —          |
| (s3)    | ○                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —          |
| (s4)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —          |
| (d2)    | ○                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —          |

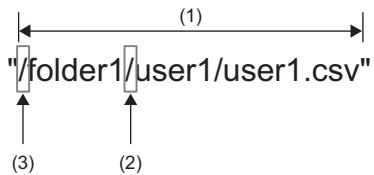
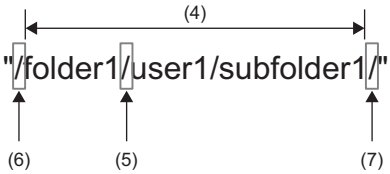
### ■Control data (d1)

| Device | Item                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Setting range                      | Set by |
|--------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------|
| +0     | Application setting area | <p>b15                      ...                      b2    b1    b0<br/> <div style="border: 1px solid black; padding: 2px; width: fit-content;"> <span style="margin-right: 10px;">0</span> <span style="border: 1px solid black; padding: 0 5px;">1/0</span> <span style="border: 1px solid black; padding: 0 5px;">1/0</span> <span style="border: 1px solid black; padding: 0 5px;">1/0</span> </div> </p> <p>■b0, b2: Target type setting<br/>           b0: Specify the type of data (file or folder) to move.<br/>                 0: File<br/>                 1: Folder<br/>           b2: Specify how the data is moved. (This bit is valid when b0 is set to 1 (Folder).)<br/>                 0: Move the folder in its entirety.<br/>                 1: Move all the files and subfolders in the folder.</p> <ul style="list-style-type: none"> <li>• Operation when b2 is set to 0 (Move the folder in its entirety).</li> </ul> <p>The specified folder (including all files and subfolders in it) is moved in its entirety.</p> | Refer to the "Description" column. | User   |

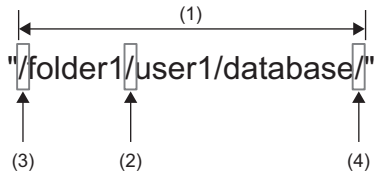
| Operand: (d1) |                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                    |        |
|---------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------|
| Device        | Item                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Setting range                      | Set by |
| +0            | Application setting area | <p>• Operation when b2 is set to 1 (Move all the files and subfolders in the folder), and the specified folder includes files and a subfolder<br/>All the files and subfolders in the specified folder are moved.</p> <p>• Operation when b2 is set to 1 (Move all the files and subfolders in the folder), and the specified folder includes only files (no subfolder)<br/>All the files in the specified folder are moved.</p> <p>■b1: Overwrite setting<br/>Specify whether to overwrite a file or a folder if one with the same name as the source already exists in the destination.</p> <ul style="list-style-type: none"> <li>• 0: Do not overwrite the file or folder.</li> <li>• 1: Overwrite the file or folder.</li> </ul> | Refer to the "Description" column. | User   |
| +1            | Completion status        | <p>The completion status is stored upon completion of the instruction.</p> <ul style="list-style-type: none"> <li>• 0000H: Completed successfully</li> <li>• Other than 0000H: Completed with an error (error code) ( Page 663 Error codes generated for file operation instructions)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                      | —                                  | System |



## ■File name/folder name (s2)

| Operand: (s2) |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |        |
|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|
| Device        | Item                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Setting range  | Set by |
| +0 to +□      | File name/folder name | <p>When specifying a file, specify the folder path where the file to move is stored and the file name.</p> <p>When specifying a folder, specify the folder path of the folder to move.</p> <ul style="list-style-type: none"> <li>• If the file name has an extension, do not omit it.</li> <li>• The file name, including the period and extension, must be within 64 characters.</li> <li>• The folder path and file name (including the period and extension) must be within 253 characters in total.</li> <li>• The folder path must be within 244 characters. (Delimiters are not included.)</li> <li>• Specify one character or more for the file name or folder path in addition to a delimiter.</li> <li>• When specifying a file, do not add a delimiter at the end of a string.</li> <li>• Do not put a period (one-byte) at the end of a string or directly before each delimiter.</li> <li>• The number of folder path hierarchies must be within 10 levels.</li> </ul> <p>■When a file is specified</p>  <p>(1) Up to 253 characters<br/> (2) Use "/" or "\" as delimiters for the folder path and file.<br/> (3) Can be omitted. When it is omitted, (1) is up to 252 characters.</p> <p>■When a folder is specified</p>  <p>(4) Up to 244 characters<br/> (5) Use "/" or "\" as delimiters for the folder path.<br/> (6) Can be omitted. When it is omitted, (4) is up to 243 characters.<br/> (7) Can be omitted.</p> | Unicode string | User   |

## ■Destination folder path (s4)

| Operand: (s4) |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |        |
|---------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|
| Device        | Item        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Setting range  | Set by |
| +0 to +□      | Folder path | <p>Specify the destination folder path.</p> <ul style="list-style-type: none"> <li>• The folder path must be within 244 characters. (Delimiters are not included.)</li> <li>• Specify one character or more for the folder path in addition to a delimiter.</li> <li>• Do not put a space (one-byte) at the end of a string or directly before each delimiter.</li> <li>• Do not put a period (one-byte) at the end of a string or directly before each delimiter.</li> <li>• The number of folder path hierarchies must be within 10 levels.</li> </ul>  <p>(1) Up to 244 characters<br/> (2) Use "/" or "\" as delimiters for the folder path and file.<br/> (3) Can be omitted. When it is omitted, (1) is up to 243 characters.<br/> (4) Can be omitted.</p> | Unicode string | User   |

## Processing details

- This instruction moves the file or folder specified by (s2) in the drive specified by (s1) to the folder specified by (s4) in the drive specified by (s3). If the folder specified by (s4) does not exist in the destination, the folder is created automatically.
- SM753 (File being accessed) turns on while the SP.FMOVE instruction is being executed. While SM753 is on, the SP.FMOVE instruction cannot be executed. (If the instruction is executed, no processing is performed.)
- The processing completion bit device (d2) automatically turns on at the execution of the END instruction in the scan in which the completion of processing of the SP.FMOVE instruction is detected. The bit device (d2) turns off at the execution of the END instruction in the next scan.
- If the SP.FMOVE instruction completes with an error, the error completion device (d2)+1 turns on or off in synchronization with (d2).
- If an operation error is detected during the execution of the instruction, (d2) and (d2)+1 do not turn on.

## Precautions

- Do not execute the SP.FMOVE instruction in an interrupt program. Doing so may cause malfunction of the module.
- Even though the operating status of the controller is switched from RUN to STOP during instruction execution, the controller continues the processing of the instruction.
- Ensure that the number of characters in a folder path or in the total of a folder path and a file name after moving does not exceed its limit. (The file may be corrupt or an error may occur.)
- If overwriting occurs, the time to complete the instruction may be extended.
- When overwriting occurs, ensure a free space of the same size as the operation target file.
- If the instruction is completed with an error during processing, the file or folder may remain under processing.
- If the size of a file to be moved or the number of files to be moved becomes larger due to overwriting, the instruction will take more time to complete.
- Do not access the file being processed by the SP.FMOVE instruction from other functions. (The file may be inaccessible or an error may occur.)
- Do not operate files or folders being accessed from other functions.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | <p>The drive specified by (s1) is not the one for the SD memory card.</p> <p>The file name/folder name string specified by (s2) cannot be read.</p> <ul style="list-style-type: none"><li>• The specified file name string contains no character.</li><li>• The specified file name string contains 254 characters or more.</li><li>• The specified folder path contains 245 characters or more.</li><li>• The specified folder path hierarchies contains 11 levels or more.</li><li>• When a file is specified, the file name string ends with a delimiter.</li><li>• The specified file name string has a period (one-byte) at its end or directly before each delimiter.</li></ul> <p>The folder path string specified by (s4) cannot be read.</p> <ul style="list-style-type: none"><li>• The specified file path string contains no character.</li><li>• The specified folder path string contains 245 characters or more.</li><li>• The specified folder path hierarchies contains 11 levels or more.</li><li>• The specified folder path string has a space (one-byte) at its end or directly before each delimiter.</li><li>• The specified folder path string has a period (one-byte) at its end or directly before each delimiter.</li></ul> <p>A system folder (\$MELPRJ\$) which is directly under the root folder is in the folder path specified by (s2) or (s4).</p> |

If the SP.FMOVE instruction completes with an error, an error code is stored in the device specified by (d1)+1. (Note that an error code is not stored if the instruction results in an operation error.)

For the error code stored in (d1)+1, refer to the following.

 Page 663 Error codes generated for file operation instructions

# Renaming the specified file

## SP.FRENAME

This instruction renames the specified file or folder in an SD memory card.

| Ladder | ST                                               |
|--------|--------------------------------------------------|
|        | <pre>ENO:=SP_FRENAME(EN,U,s1,s2,s3,d1,d2);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SP.FRENAME  |                     |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                                                 | Range                      | Data type      | Data type (label)                       |
|---------|-----------------------------------------------------------------------------|----------------------------|----------------|-----------------------------------------|
| (U)     | Dummy                                                                       | —                          | Device name    | ANY16                                   |
| (s1)    | Drive specification                                                         | 2 (fixed)*1                | Word           | ANY16                                   |
| (d1)    | Start device where the control data is stored                               | Page 658 Control data (d1) | Word           | ANY16_ARRAY<br>(Number of elements: 2)  |
| (s2)    | Start device where the file name or folder name to be changed is stored     | —                          | Unicode string | ANYSTRING_DOUBLE                        |
| (s3)    | Start device where the new file name/folder name after the change is stored | —                          | Unicode string | ANYSTRING_DOUBLE                        |
| (d2)    | Bit device that turns on upon completion of the processing                  | —                          | Bit            | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                         | —                          | Bit            | BOOL                                    |
| ENO     | Execution result                                                            | —                          | Bit            | BOOL                                    |

\*1 Only drive 2 (for the SD memory card) can be set.

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | —                                | —   | —                                     | —           | — | —           | —  | —                      | —        | — | —  | ○          |
| (s1)    | ○                                | —   | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —          |
| (d1)    | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —          |
| (s2)    | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —          |
| (s3)    | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —          |
| (d2)    | ○                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —          |

## ■Control data (d1)

| Operand: (d1) |                          |                                                                                                                                                                                                                                                                                                                                                                                    |                                    |        |
|---------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------|
| Device        | Item                     | Description                                                                                                                                                                                                                                                                                                                                                                        | Setting range                      | Set by |
| +0            | Application setting area | <div> <div> <div>b15</div> <div>...</div> <div>b0</div> </div> <div> <div>0</div> <div>1/0</div> </div> </div> <p>b0: Target type setting<br/>Specify the type of data (file or folder) to delete.</p> <ul style="list-style-type: none"> <li>• 0: File</li> <li>• 1: Folder</li> </ul>                                                                                            | Refer to the "Description" column. | User   |
| +1            | Completion status        | <p>The completion status is stored upon completion of the instruction.</p> <ul style="list-style-type: none"> <li>• 0000H: Completed successfully</li> <li>• Other than 0000H: Completed with an error (error code) (  Page 663 Error codes generated for file operation instructions)</li> </ul> | —                                  | System |

## ■File name/folder name to be changed (s2)

| Operand: (s2) |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |        |
|---------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|
| Device        | Item                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Setting range  | Set by |
| +0 to +□      | File name/folder name | <p>When specifying a file, specify the folder path where the file to be renamed is stored and the file name.</p> <p>When specifying a folder, specify the folder path of the folder to be renamed.</p> <ul style="list-style-type: none"> <li>• If the file name has an extension, do not omit it.</li> <li>• The file name, including the period and extension, must be within 64 characters.</li> <li>• The folder path and file name (including the period and extension) must be within 253 characters in total.</li> <li>• The folder path must be within 244 characters. (Delimiters are not included.)</li> <li>• Specify one character or more for the file name or folder path in addition to a delimiter.</li> <li>• When specifying a file, do not add a delimiter at the end of a string.</li> <li>• Do not put a period (one-byte) at the end of a string or directly before each delimiter.</li> <li>• The number of folder path hierarchies must be within 10 levels.</li> </ul> <p>■When a file is specified</p> <div> <div>(1)</div> <div>"folder1/user1/user1.csv"</div> <div>(3)</div> <div>(2)</div> </div> <p>(1) Up to 253 characters<br/>(2) Use "/" or "\" as delimiters for the folder path and file.<br/>(3) Can be omitted. When it is omitted, (1) is up to 252 characters.</p> <p>■When a folder is specified</p> <div> <div>(4)</div> <div>"folder1/user1/subfolder1/"</div> <div>(6)</div> <div>(5)</div> <div>(7)</div> </div> <p>(4) Up to 244 characters<br/>(5) Use "/" or "\" as delimiters for the folder path.<br/>(6) Can be omitted. When it is omitted, (4) is up to 243 characters.<br/>(7) Can be omitted.</p> | Unicode string | User   |

## ■File name/folder name after the change (s3)

| Operand: (s3) |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |        |
|---------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|
| Device        | Item                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Setting range  | Set by |
| +0 to +□      | File name/folder name | Specify the string of the file name/folder name after the change. <ul style="list-style-type: none"> <li>Do not specify a folder path.</li> <li>The file name (including the period and extension) must be within 64 characters.</li> <li>The folder name must be within 243 characters.</li> <li>Specify one character or more for the file name or folder name.</li> <li>Do not specify a delimiter.</li> <li>Do not put a period (one-byte) at the end of a string.</li> </ul> | Unicode string | User   |

### Processing details

- This instruction rename the file or folder specified by (s2) in the drive specified by (s1) to the file name or folder name specified by (s3). If the file name or folder name specified by (s3) already exists, the instruction is completed with an error.
- SM753 (File being accessed) turns on while the SP.FRENAME instruction is being executed. While SM753 is on, the SP.FRENAME instruction cannot be executed. (If the instruction is executed, no processing is performed.)
- The processing completion bit device (d2) automatically turns on at the execution of the END instruction in the scan in which the completion of processing of the SP.FRENAME instruction is detected. The bit device (d2) turns off at the execution of the END instruction in the next scan.
- If the SP.FRENAME instruction completes with an error, the error completion device (d2)+1 turns on or off in synchronization with (d2).
- If an operation error is detected during the execution of the instruction, (d2) and (d2)+1 do not turn on.

### Precautions

- Do not execute the SP.FRENAME instruction in an interrupt program. Doing so may cause malfunction of the module.
- Even though the operating status of the controller is switched from RUN to STOP during instruction execution, the controller continues the processing of the instruction.
- Ensure that the number of characters in a folder path or in the total of a folder path and a file name after changing does not exceed its limit. (The file may be inaccessible or an error may occur.)
- Do not access the file being processed by the SP.FRENAME instruction from other functions. (The file may be corrupt or an error may occur.)
- Do not operate files or folders being accessed from other functions.

### Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | <p>The drive specified by (s1) is not the one for the SD memory card.</p> <p>The file name/folder name string specified by (s2) cannot be read.</p> <ul style="list-style-type: none"> <li>The specified file name string contains no character.</li> <li>The specified file name string contains 254 characters or more.</li> <li>The specified folder path contains 245 characters or more.</li> <li>The specified folder path hierarchies contains 11 levels or more.</li> <li>When a file is specified, the file name string ends with a delimiter.</li> <li>The specified file name string has a period (one-byte) at its end or directly before each delimiter.</li> </ul> <p>The file name/folder name string specified by (s3) cannot be read.</p> <ul style="list-style-type: none"> <li>The specified file name/folder name string contains no character.</li> <li>The specified file name string contains 253 characters or more.</li> <li>The specified folder name string contains 244 characters or more.</li> <li>The specified file name string contains a delimiter.</li> <li>The specified file name string has a period (one-byte) at its end.</li> </ul> <p>A system folder (\$MELPRJ\$) which is directly under the root folder is in the folder path specified by (s2).</p> <p>\$MELPRJ\$ is specified for the file name/folder name specified by (s3).</p> |

If the SP.FRENAME instruction completes with an error, an error code is stored in the device specified by (d1)+1. (Note that an error code is not stored if the instruction results in an operation error.)

For the error code stored in (d1)+1, refer to the following.

📖 Page 663 Error codes generated for file operation instructions

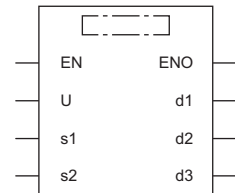
# Acquiring the status of the specified file

## SP.FSTATUS

This instruction acquires the status of the specified file or folder in an SD memory card.

| Ladder | ST                                    |
|--------|---------------------------------------|
|        | ENO:=SP_FSTATUS(EN,U,s1,s2,d1,d2,d3); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SP.FSTATUS  |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                | Range                        | Data type      | Data type (label)                       |
|---------|------------------------------------------------------------|------------------------------|----------------|-----------------------------------------|
| (U)     | Dummy                                                      | —                            | Device name    | ANY16                                   |
| (s1)    | Drive specification                                        | 2 (fixed)**1                 | Word           | ANY16                                   |
| (d1)    | Start device where the control data is stored              | ☞ Page 661 Control data (d1) | Word           | ANY16_ARRAY<br>(Number of elements: 2)  |
| (s2)    | Start device where the file name or folder name is stored  | —                            | Unicode string | ANYSTRING_DOUBLE                        |
| (d2)    | Start device for storing the file status                   | —                            | Word           | ANY16_ARRAY<br>(Number of elements: 10) |
| (d3)    | Bit device that turns on upon completion of the processing | —                            | Bit            | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                        | —                            | Bit            | BOOL                                    |
| ENO     | Execution result                                           | —                            | Bit            | BOOL                                    |

\*1 Only drive 2 (for the SD memory card) can be set.

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | —                                | —   | —                                     | —          | — | —           | —  | —                      | —        | — | —  | ○          |
| (s1)    | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —          |
| (d1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —          |
| (d2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |
| (d3)    | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |

## ■Control data (d1)

| Operand: (d1) |                          |                                                                                                                                                                                                                                                                                                                                                                                    |                                    |        |
|---------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------|
| Device        | Item                     | Description                                                                                                                                                                                                                                                                                                                                                                        | Setting range                      | Set by |
| +0            | Application setting area | <div> <div> <div>b15</div> <div>...</div> <div>b0</div> </div> <div> <div>0</div> <div>1/0</div> </div> </div> <p>b0: Target type setting<br/>Specify the type of data (file or folder) to acquire the status.</p> <ul style="list-style-type: none"> <li>• 0: File</li> <li>• 1: Folder</li> </ul>                                                                                | Refer to the "Description" column. | User   |
| +1            | Completion status        | <p>The completion status is stored upon completion of the instruction.</p> <ul style="list-style-type: none"> <li>• 0000H: Completed successfully</li> <li>• Other than 0000H: Completed with an error (error code) (  Page 663 Error codes generated for file operation instructions)</li> </ul> | —                                  | System |

## ■File name/folder name (s2)

| Operand: (s2) |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |        |
|---------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|
| Device        | Item                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Setting range  | Set by |
| +0 to +□      | File name/folder name | <p>When specifying a file, specify the folder path where the file whose status is to be acquired is stored and the file name.<br/>When specifying a folder, specify the folder path of the folder whose status is to be acquired.</p> <ul style="list-style-type: none"> <li>• If the file name has an extension, do not omit it.</li> <li>• The file name, including the period and extension, must be within 64 characters.</li> <li>• The folder path and file name (including the period and extension) must be within 253 characters in total.</li> <li>• The folder path must be within 244 characters. (Delimiters are not included.)</li> <li>• Specify one character or more for the file name or folder path in addition to a delimiter.</li> <li>• When specifying a file, do not add a delimiter at the end of a string.</li> <li>• Do not put a period (one-byte) at the end of a string or directly before each delimiter.</li> <li>• The number of folder path hierarchies must be within 10 levels.</li> </ul> <p>■When a file is specified</p> <div> <div>(1)</div> <div>"folder1/user1/user1.csv"</div> <div>(3)</div> <div>(2)</div> </div> <p>(1) Up to 253 characters<br/>(2) Use "/" or "\" as delimiters for the folder path and file.<br/>(3) Can be omitted. When it is omitted, (1) is up to 252 characters.</p> <p>■When a folder is specified</p> <div> <div>(4)</div> <div>"folder1/user1/subfolder1/"</div> <div>(6)</div> <div>(5)</div> <div>(7)</div> </div> <p>(4) Up to 244 characters<br/>(5) Use "/" or "\" as delimiters for the folder path.<br/>(6) Can be omitted. When it is omitted, (4) is up to 243 characters.<br/>(7) Can be omitted.</p> | Unicode string | User   |

## ■File status (d2)

| Operand: (d2) |                                                                                                                                                                                                                                                                              |                               |        |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------|
| Device        | Item                                                                                                                                                                                                                                                                         | Range                         | Set by |
| +0            | File attribute<br>bit0: Turns on for a read-only file.<br>bit1: Turns on for a hidden file.<br>bit2: Turns on for a system file.<br>bit3: Reserved (fixed to 0)<br>bit4: Turns on for a directory.<br>bit5: Turns on for an archive.<br>bit6 to bit15: Reserved (fixed to 0) | Refer to the "Item" column.   | System |
| +1            | Reserved                                                                                                                                                                                                                                                                     | 0                             |        |
| +2 to +3      | File size (in units of bytes)                                                                                                                                                                                                                                                | 0 to 4294967294* <sup>1</sup> |        |
| +4            | Last update date/time: Year                                                                                                                                                                                                                                                  | 0, 1980~2079* <sup>1</sup>    |        |
| +5            | Last update date/time: Month                                                                                                                                                                                                                                                 | 0 to 12                       |        |
| +6            | Last update date/time: Day                                                                                                                                                                                                                                                   | 0 to 31                       |        |
| +7            | Last update date/time: Hour                                                                                                                                                                                                                                                  | 0 to 23                       |        |
| +8            | Last update date/time: Minute                                                                                                                                                                                                                                                | 0 to 59                       |        |
| +9            | Last update date/time: Second                                                                                                                                                                                                                                                |                               |        |

\*1 For files/folders accessed in an environment (OS) other than the controller, the range of values to be acquired depends on the environment (OS).

### Processing details

- This function acquires the status of the file or folder specified by (s2) in the drive specified by (s1) and stores it in the device (d2) and after. When a folder is specified by (s2), 0 is stored in (d2)+2 to (d2)+3.
- SM753 (File being accessed) turns on while the SP.FSTATUS instruction is being executed. While SM753 is on, the SP.FSTATUS instruction cannot be executed. (If the instruction is executed, no processing is performed.)
- The processing completion bit device (d3) automatically turns on at the execution of the END instruction in the scan in which the completion of processing of the SP.FSTATUS instruction is detected. The bit device (d3) turns off at the execution of the END instruction in the next scan.
- If the SP.FSTATUS instruction completes with an error, the error completion device (d3)+1 turns on or off in synchronization with (d3).
- If an operation error is detected during the execution of the instruction, the processing completion (d3) and the error completion ((d3)+1) do not turn on.

### Precautions

- Do not execute the SP.FSTATUS instruction in an interrupt program. Doing so may cause malfunction of the module.
- Even though the operating status of the controller is switched from RUN to STOP during instruction execution, the controller continues the processing of the instruction.

### Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | <p>The drive specified by (s1) is not the one for the SD memory card.</p> <p>The file name/folder name string specified by (s2) cannot be read.</p> <ul style="list-style-type: none"> <li>• The specified file name string contains no character.</li> <li>• The specified file name string contains 254 characters or more.</li> <li>• The specified folder path contains 245 characters or more.</li> <li>• The specified folder path hierarchies contains 11 levels or more.</li> <li>• When a file is specified, the file name string ends with a delimiter.</li> <li>• The specified file name string has a period (one-byte) at its end or directly before each delimiter.</li> </ul> |

If the SP.FSTATUS instruction completes with an error, an error code is stored in the device specified by (d1)+1. (Note that an error code is not stored if the instruction results in an operation error.)

For the error code stored in (d1)+1, refer to the following.

 Page 663 Error codes generated for file operation instructions



## Error codes generated for file operation instructions

The following table lists the error codes that could be stored in the completion status of file operation instructions.

| Error code | Description                                                                                                                                                                                                                                    | Action                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8000H      | SM606 (SD memory card forced disable instruction) is on.                                                                                                                                                                                       | Turn off SM606 to cancel the SD memory card forced disable status.                                                                                                                                                                                                                                                                                                                                                                        |
|            | No SD memory card is inserted.                                                                                                                                                                                                                 | Insert an SD memory card.                                                                                                                                                                                                                                                                                                                                                                                                                 |
|            | The SD memory card is not mounted.                                                                                                                                                                                                             | Mount the SD memory card.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 8001H      | An access to the SD memory card has failed.                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>• Check that the file name string are correctly specified.</li> <li>• Check that no other functions are accessing the file.</li> <li>• Take measures to reduce noise.</li> <li>• Reset the controller and RUN it again. If the same error code is displayed again, the possible cause is a hardware failure of the SD memory card. Please contact your local Mitsubishi representative.</li> </ul> |
|            | The SD memory card is write-protected.                                                                                                                                                                                                         | Unlock the write protect switch of the SD memory card.                                                                                                                                                                                                                                                                                                                                                                                    |
|            | The file is set for read only.                                                                                                                                                                                                                 | Clear the read-only setting.                                                                                                                                                                                                                                                                                                                                                                                                              |
|            | The size of the file to be stored in the SD memory card exceeds the free space or the maximum capacity of the SD memory card.                                                                                                                  | <ul style="list-style-type: none"> <li>• Delete unnecessary files in the SD memory card to secure free space.</li> <li>• Adjust the file size so that it is equal to or less than its limit.</li> </ul>                                                                                                                                                                                                                                   |
|            |                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 8002H      | The specified file or folder does not exist.                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>• Check that the specified file or folder exists.</li> <li>• Check that the specified folder path exists.</li> </ul>                                                                                                                                                                                                                                                                               |
|            | The free space in the SD memory card is insufficient.                                                                                                                                                                                          | Delete unnecessary files in the SD memory card to secure free space.                                                                                                                                                                                                                                                                                                                                                                      |
| 8003H      | The total number of data read from the file has exceeded (d1)+3 (Maximum number of read data).                                                                                                                                                 | Adjust (d1)+2 (Number of read-target data) or (d1)+3 (Maximum number of read data).                                                                                                                                                                                                                                                                                                                                                       |
| 8004H      | The folder to be deleted is not empty.                                                                                                                                                                                                         | Check the setting of the control data.                                                                                                                                                                                                                                                                                                                                                                                                    |
| 8005H      | A file or folder with the same name exists.                                                                                                                                                                                                    | Change the name of the file or folder.                                                                                                                                                                                                                                                                                                                                                                                                    |
| 8006H      | <ul style="list-style-type: none"> <li>• A folder whose folder path will exceed 244 characters after instruction execution exists.</li> <li>• A file whose file path will exceed 253 characters after instruction execution exists.</li> </ul> | Ensure that the folder path or file path after instruction execution will not exceed the maximum number of characters.                                                                                                                                                                                                                                                                                                                    |
|            | The following folder/subfolder is specified for the copy or move destination. <ul style="list-style-type: none"> <li>• Same folder/subfolder as the copy source</li> <li>• Same folder/subfolder as the move source</li> </ul>                 | Change the copy or move destination path.                                                                                                                                                                                                                                                                                                                                                                                                 |

# 14.5 Data Control Instructions

## Upper and lower limit control of 16-bit binary data

### LIMIT(P)(\_U)

These instructions control the output value depending on whether the specified 16-bit binary bit value is within the upper and lower limits.

| Ladder | ST*1                        |                               |
|--------|-----------------------------|-------------------------------|
|        | ENO:=LIMITP(EN,s1,s2,s3,d); | ENO:=LIMITP_U(EN,s1,s2,s3,d); |

| FBD/LD*1 |
|----------|
|          |

\*1 The LIMIT and LIMIT\_U instructions do not support the ST and FBD/LD. Use the standard function, LIMIT.  
📖 Page 1362 LIMIT(\_E)

### ■Execution condition

| Instruction        | Execution condition |
|--------------------|---------------------|
| LIMIT<br>LIMIT_U   |                     |
| LIMITP<br>LIMITP_U |                     |

## Setting data

### ■ Descriptions, ranges, and data types

| Operand | Description         | Range           | Data type              | Data type (label) |
|---------|---------------------|-----------------|------------------------|-------------------|
| (s1)    | LIMIT(P)            | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | LIMIT(P)_U          | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (s2)    | LIMIT(P)            | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | LIMIT(P)_U          | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (s3)    | LIMIT(P)            | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | LIMIT(P)_U          | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (d)     | LIMIT(P)            | —               | 16-bit signed binary   | ANY16_S           |
|         | LIMIT(P)_U          | —               | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition | —               | Bit                    | BOOL              |
| ENO     | Execution result    | —               | Bit                    | BOOL              |

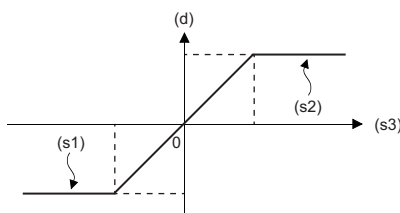
### ■ Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K        | H | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | — | —  | —      |
| (s3)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | — | —  | —      |

## Processing details

- These instructions control the output value to be stored in the device specified by (d) by checking the input value (16-bit binary data) in the device specified by (s3) with the upper and lower limit values specified by (s1) and (s2). The output value is controlled as follows.

| Condition                                                          | Output value           |
|--------------------------------------------------------------------|------------------------|
| Lower limit value (s1) > Input value (s3)                          | Lower limit value (s1) |
| Upper limit value (s2) < Input value (s3)                          | Upper limit value (s2) |
| Lower limit value (s1) ≤ Input value (s3) ≤ Upper limit value (s2) | Input value (s3)       |



- To control the input value only with the upper limit, set the minimum value within the setting range in (s1).
- To control the input value only with the lower limit, set the maximum value within the setting range in (s2).

## Operation error

| Error code (SD0) | Description                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------|
| 3285H            | The lower limit value specified by (s1) is greater than the upper limit value specified by (s2). |

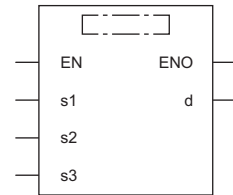
# Upper and lower limit control of 32-bit binary data

## DLIMIT(P)(\_U)

These instructions control the output value depending on whether the specified 32-bit binary bit value is within the upper and lower limits.

| Ladder | ST <sup>*1</sup>             |                                |
|--------|------------------------------|--------------------------------|
|        | ENO:=DLIMITP(EN,s1,s2,s3,d); | ENO:=DLIMITP_U(EN,s1,s2,s3,d); |

## FBD/LD<sup>\*1</sup>



<sup>\*1</sup> The DLIMIT and DLIMIT\_U instructions do not support the ST and FBD/LD. Use the standard function, LIMIT.

Page 1362 LIMIT(\_E)

## Execution condition

| Instruction          | Execution condition |
|----------------------|---------------------|
| DLIMIT<br>DLIMIT_U   |                     |
| DLIMITP<br>DLIMITP_U |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                                               | Range                     | Data type              | Data type (label) |
|---------|-------------------------------------------------------------------------------------------|---------------------------|------------------------|-------------------|
| (s1)    | DLIMIT(P)<br>Device for storing the lower limit value (minimum output threshold value)    | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | DLIMIT(P)_U<br>Device for storing the lower limit value (minimum output threshold value)  | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (s2)    | DLIMIT(P)<br>Device for storing the upper limit value (maximum output threshold value)    | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | DLIMIT(P)_U<br>Device for storing the upper limit value (maximum output threshold value)  | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (s3)    | DLIMIT(P)<br>Device for storing the input value controlled by upper/lower limit control   | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | DLIMIT(P)_U<br>Device for storing the input value controlled by upper/lower limit control | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (d)     | DLIMIT(P)<br>Start device for storing the controlled output value                         | —                         | 32-bit signed binary   | ANY32_S           |
|         | DLIMIT(P)_U<br>Start device for storing the controlled output value                       | —                         | 32-bit unsigned binary | ANY32_U           |
| EN      | Execution condition                                                                       | —                         | Bit                    | BOOL              |
| ENO     | Execution result                                                                          | —                         | Bit                    | BOOL              |

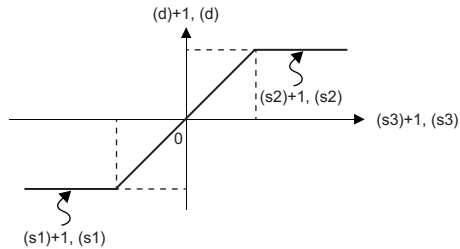
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | — | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | — | —      |
| (s3)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | — | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | — | —      |

## Processing details

- These instructions control the output value to be stored in the device specified by (d) by checking the input value (32-bit binary data) in the device specified by (s3) with the upper and lower limit values specified by (s1) and (s2). The output value is controlled as follows.

| Condition                                                                                        | Output value                     |
|--------------------------------------------------------------------------------------------------|----------------------------------|
| Lower limit value ((s1), (s1)+1) > Input value ((s3), (s3)+1)                                    | Lower limit value ((s1), (s1)+1) |
| Lower limit value ((s2), (s2)+1) < Input value ((s3), (s3)+1)                                    | Upper limit value ((s2), (s2)+1) |
| Lower limit value ((s1), (s1)+1) ≤ Input value ((s3), (s3)+1) ≤ Upper limit value ((s2), (s2)+1) | Input value ((s3), (s3)+1)       |



- To control the input value only with the upper limit, set the minimum value within the setting range in (s1).
- To control the input value only with the lower limit, set the maximum value within the setting range in (s2).

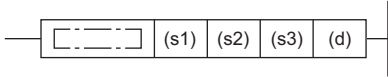
## Operation error

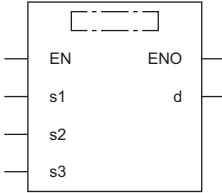
| Error code (SD0) | Description                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------|
| 3285H            | The lower limit value specified by (s1) is greater than the upper limit value specified by (s2). |

# Dead band control of 16-bit binary data

## BAND(P)(\_U)

These instructions control the output value depending on whether the specified 16-bit binary bit value is within the upper and lower limits of the dead band.

| Ladder                                                                            | ST                                                      |                                                             |
|-----------------------------------------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------------|
|  | ENO:=BAND(EN,s1,s2,s3,d);<br>ENO:=BANDP(EN,s1,s2,s3,d); | ENO:=BAND_U(EN,s1,s2,s3,d);<br>ENO:=BANDP_U(EN,s1,s2,s3,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction      | Execution condition                                                                |
|------------------|------------------------------------------------------------------------------------|
| BAND<br>BAND_U   |   |
| BANDP<br>BANDP_U |  |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description         | Range           | Data type              | Data type (label) |
|---------|---------------------|-----------------|------------------------|-------------------|
| (s1)    | BAND(P)             | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | BAND(P)_U           | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (s2)    | BAND(P)             | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | BAND(P)_U           | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (s3)    | BAND(P)             | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | BAND(P)_U           | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (d)     | BAND(P)             | —               | 16-bit signed binary   | ANY16_S           |
|         | BAND(P)_U           | —               | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition | —               | Bit                    | BOOL              |
| ENO     | Execution result    | —               | Bit                    | BOOL              |

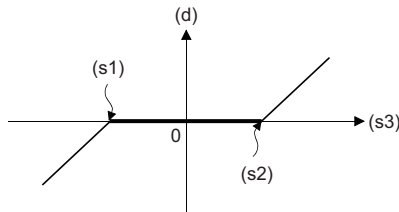
## Applicable devices

| Operand | Bit                              |     | Word                                  |           | Z | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (s1)    | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | — | —      |
| (s2)    | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | — | —      |
| (s3)    | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | — | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | —        | — | —  | — | —      |

## Processing details

- These instructions control the output value to be stored in the device specified by (d) by checking whether the input value (16-bit binary data) in the device specified by (s3) is within range of the upper and lower limits of the dead band in the devices specified by (s1) and (s2). The output value is controlled as follows.

| Condition                                                                        | Output value                                        |
|----------------------------------------------------------------------------------|-----------------------------------------------------|
| Dead band lower limit value (s1) > input value (s3)                              | Input value (s3) - dead band lower limit value (s1) |
| Dead band upper limit value (s2) < input value (s3)                              | Input value (s3) - dead band upper limit value (s2) |
| Dead band lower limit value (s1) ≤ input value (s3) ≤ dead band upper limit (s2) | 0                                                   |



- The following example shows the case where the operation result of the BAND(P) instruction is out of the range from -32768 to 32767.

**Ex.**

When (s1) is 10 and (s3) is -32768, output value is  $-32768 - 10 = 8000\text{H} - 000\text{AH} = 7\text{FF}6\text{H} = 32758$ .

- The following example shows the case when the operation result of the BAND(P)\_U instruction is out of the range from 0 to 65535.

**Ex.**

When (s1) is 100 and (s3) is 50, output value is  $50 - 100 = 0032\text{H} - 0064\text{H} = \text{FFCEH} = 65486$ .

## Operation error

| Error code (SD0) | Description                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------|
| 3285H            | The lower limit value specified by (s1) is greater than the upper limit value specified by (s2). |

# Dead band control of 32-bit binary data

## DBAND(P)(\_U)

These instructions control the output value depending on whether the specified 32-bit binary bit value is within the upper and lower limits of the dead band.

| Ladder | ST                                                        |                                                               |
|--------|-----------------------------------------------------------|---------------------------------------------------------------|
|        | ENO:=DBAND(EN,s1,s2,s3,d);<br>ENO:=DBANDP(EN,s1,s2,s3,d); | ENO:=DBAND_U(EN,s1,s2,s3,d);<br>ENO:=DBANDP_U(EN,s1,s2,s3,d); |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction        | Execution condition |
|--------------------|---------------------|
| DBAND<br>DBAND_U   |                     |
| DBANDP<br>DBANDP_U |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description            | Range                                        | Data type                                      | Data type (label)  |
|---------|------------------------|----------------------------------------------|------------------------------------------------|--------------------|
| (s1)    | DBAND(P)<br>DBAND(P)_U | -2147483648 to 2147483647<br>0 to 4294967295 | 32-bit signed binary<br>32-bit unsigned binary | ANY32_S<br>ANY32_U |
| (s2)    | DBAND(P)<br>DBAND(P)_U | -2147483648 to 2147483647<br>0 to 4294967295 | 32-bit signed binary<br>32-bit unsigned binary | ANY32_S<br>ANY32_U |
| (s3)    | DBAND(P)<br>DBAND(P)_U | -2147483648 to 2147483647<br>0 to 4294967295 | 32-bit signed binary<br>32-bit unsigned binary | ANY32_S<br>ANY32_U |
| (d)     | DBAND(P)<br>DBAND(P)_U | —                                            | 32-bit signed binary<br>32-bit unsigned binary | ANY32_S<br>ANY32_U |
| EN      | Execution condition    | —                                            | Bit                                            | BOOL               |
| ENO     | Execution result       | —                                            | Bit                                            | BOOL               |

## Applicable devices

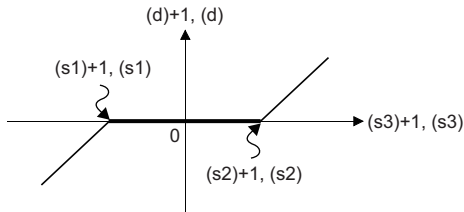
| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (s1)    | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | ○        | — | —  | — | —      |
| (s2)    | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | ○        | — | —  | — | —      |
| (s3)    | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | ○        | — | —  | — | —      |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | — | —  | — | —      |



## Processing details

- These instructions control the output value to be stored in the device specified by (d) by checking whether the input value (32-bit binary data) in the device specified by (s3) is within range of the upper and lower limits of the dead band in the devices specified by (s1) and (s2). The output value is controlled as follows.

| Condition                                                                                                      | Output value                                                            |
|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Dead band lower limit value ((s1), (s1)+1) > Input value ((s3), (s3)+1)                                        | Input value ((s3), (s3)+1) - Dead band lower limit value ((s1), (s1)+1) |
| Dead band upper limit value ((s2), (s2)+1) < Input value ((s3), (s3)+1)                                        | Input value ((s3), (s3)+1) - Dead band upper limit value ((s2), (s2)+1) |
| Dead band lower limit value ((s1), (s1)+1) ≤ Input value ((s3), (s3)+1) ≤ Dead band upper limit ((s2), (s2)+1) | 0                                                                       |



- The following example shows the case when the operation result of the DBAND(P) instruction is out of the range from -2147483648 to 2147483647.

**Ex.**

When ((s1), (s1)+1) is 1000 and ((s3), (s3)+1) is -2147483648, output value is  $-2147483648 - 1000 = 80000000\text{H} - 000003\text{E8H} = 7\text{FFFFFFC18H} = 2147482648$ .

- The following example shows the case when the operation result of the DBAND(P)\_U instruction is out of the range from 0 to 4294967295.

**Ex.**

When ((s1), (s1)+1) is 100 and ((s3), (s3)+1) is 50, output value is  $50 - 100 = 00000032\text{H} - 00000064\text{H} = \text{FFFFFFCEH} = 4294967246$ .

## Operation error

| Error code (SD0) | Description                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------|
| 3285H            | The lower limit value specified by (s1) is greater than the upper limit value specified by (s2). |

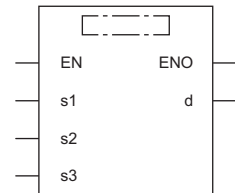
# Zone control of 16-bit binary data

## ZONE(P)(\_U)

These instructions add a bias value to the specified input value (16-bit binary).

| Ladder | ST                                                      |                                                             |
|--------|---------------------------------------------------------|-------------------------------------------------------------|
|        | ENO:=ZONE(EN,s1,s2,s3,d);<br>ENO:=ZONEP(EN,s1,s2,s3,d); | ENO:=ZONE_U(EN,s1,s2,s3,d);<br>ENO:=ZONEP_U(EN,s1,s2,s3,d); |

## FBD/LD



## Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| ZONE<br>ZONE_U   |                     |
| ZONEP<br>ZONEP_U |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                                 | Range           | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s1)    | ZONE(P)<br>Negative bias value to be added to the input value               | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | ZONE(P)_U<br>Positive bias value to be added to the input value             | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (s2)    | ZONE(P)<br>Positive bias value to be added to the input value               | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | ZONE(P)_U<br>Positive bias value to be added to the input value             | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (s3)    | ZONE(P)<br>Input value used for zone control                                | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | ZONE(P)_U<br>Input value used for zone control                              | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (d)     | ZONE(P)<br>Device for storing the output value controlled by zone control   | —               | 16-bit signed binary   | ANY16_S           |
|         | ZONE(P)_U<br>Device for storing the output value controlled by zone control | —               | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition                                                         | —               | Bit                    | BOOL              |
| ENO     | Execution result                                                            | —               | Bit                    | BOOL              |

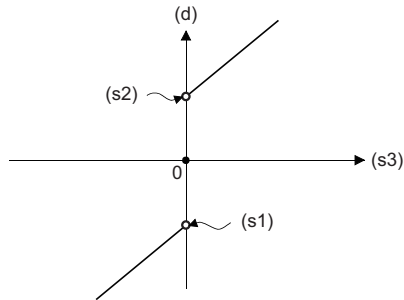
## Applicable devices

| Operand | Bit                              | Word | Double word | Indirect specification | Constant |   |   |    | Others |
|---------|----------------------------------|------|-------------|------------------------|----------|---|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY |      |             |                        | K        | H | E | \$ |        |
| (s1)    | ○                                | ○    | ○           | ○                      | ○        | — | — | —  | —      |
| (s2)    | ○                                | ○    | ○           | ○                      | ○        | — | — | —  | —      |
| (s3)    | ○                                | ○    | ○           | ○                      | ○        | — | — | —  | —      |
| (d)     | ○                                | ○    | ○           | ○                      | —        | — | — | —  | —      |

## Processing details

- These instructions add the bias value specified by (s1) or (s2) to the input value (16-bit binary) specified by (s3), and store the result in the device number specified by (d). The bias value is controlled as follows.

| Condition            | Output value                                |
|----------------------|---------------------------------------------|
| Input value (s3) < 0 | Input value (s3) + negative bias value (s1) |
| Input value (s3) < 0 | 0                                           |
| Input value (s3) < 0 | Input value (s3) + positive bias value (s2) |



- The following example shows the case where the operation result of the ZONE(P) instruction is out of the range from -32768 to 32767.

**Ex.**

When (s1) is -100 and (s3) is -32768, output value is  $-32768 + (-100) = 8000\text{H} - \text{FF}9\text{CH} = 7\text{F}9\text{CH} = 32668$ .

- The following example shows the case where the operation result of the ZONE(P)\_U instruction is out of the range from 0 to 65535.

**Ex.**

When (s2) is 100 and (s3) is 65535, output value is  $65535 + 100 = \text{FFFFH} - 0064\text{H} = 0063\text{H} = 99$ .

- The ZONE(P)\_U instruction treats the data in the device specified by (s1) as dummy and does not use it.

## Operation error

There is no operation error.

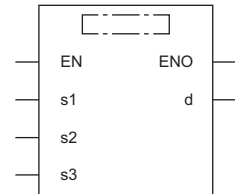
# Zone control of 32-bit binary data

## DZONE(P)(\_U)

These instructions add a bias value to the specified input value (32-bit binary).

| Ladder | ST                                                        |                                                               |
|--------|-----------------------------------------------------------|---------------------------------------------------------------|
|        | ENO:=DZONE(EN,s1,s2,s3,d);<br>ENO:=DZONEP(EN,s1,s2,s3,d); | ENO:=DZONE_U(EN,s1,s2,s3,d);<br>ENO:=DZONEP_U(EN,s1,s2,s3,d); |

## FBD/LD



### Execution condition

| Instruction        | Execution condition |
|--------------------|---------------------|
| DZONE<br>DZONE_U   |                     |
| DZONEP<br>DZONEP_U |                     |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                                                             | Range                     | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------------------------|---------------------------|------------------------|-------------------|
| (s1)    | DZONE(P)<br>Device for storing the negative bias value to be added to the input value   | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | DZONE(P)_U<br>Device for storing the positive bias value to be added to the input value | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (s2)    | DZONE(P)<br>Device for storing the positive bias value to be added to the input value   | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | DZONE(P)_U<br>Device for storing the positive bias value to be added to the input value | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (s3)    | DZONE(P)<br>Device for storing the Input value used for zone control                    | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | DZONE(P)_U<br>Device for storing the Input value used for zone control                  | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (d)     | DZONE(P)<br>Start device for storing the output value controlled by zone control        | —                         | 32-bit signed binary   | ANY32_S           |
|         | DZONE(P)_U<br>Start device for storing the output value controlled by zone control      | —                         | 32-bit unsigned binary | ANY32_U           |
| EN      | Execution condition                                                                     | —                         | Bit                    | BOOL              |
| ENO     | Execution result                                                                        | —                         | Bit                    | BOOL              |

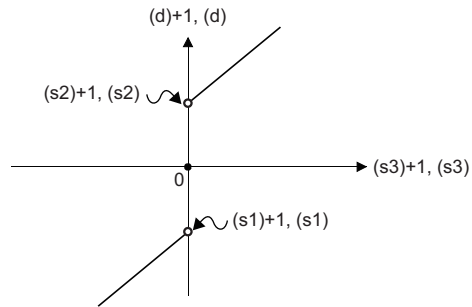
### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s3)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions add the bias value specified by (s1) or (s2) to the input value (32-bit binary) specified by (s3), and store the result in the device number specified by (d). The bias value is controlled as follows.

| Condition                      | Output value                                                  |
|--------------------------------|---------------------------------------------------------------|
| Input value ((s3), (s3)+1) < 0 | Input value ((s3), (s3)+1) + negative bias value (s1), (s1)+1 |
| Input value ((s3), (s3)+1) = 0 | 0                                                             |
| Input value ((s3), (s3)+1) > 0 | Input value ((s3), (s3)+1) + positive bias value (s2), (s2)+1 |



- The following example shows the case where the operation result of the DZONE(P) instruction is out of the range from -2147483648 to 2147483647.

**Ex.**

When ((s1), (s1)+1) is -1000 and ((s3), (s3)+1) is -2147483648, output value is  $-2147483648 + (-1000) = 80000000H - FFFFFFFC18H = 7FFFFFFC18H = 2147482648$ .

- The following example shows the case where the operation result of the DZONE(P)\_U instruction is out of the range from 0 to 4294967295.

**Ex.**

When ((s2), (s2)+1) is 1000 and ((s3), (s3)+1) is 4294967295, output value is  $4294967295 + 1000 = FFFFFFFFH - 00003E8H = 000003E7H = 999$ .

- The DZONE(P)\_U instruction treats the data in the device specified by (s1) and (s1)+1 as dummy and does not use them.

## Operation error

There is no operation error.

# Scaling 16-bit binary data (point coordinates)

## SCL(P)(\_U)

These instructions scale the scaling conversion data (16-bit data) on the basis of the specified input value (point coordinates).

| Ladder | ST                                              |                                                     |
|--------|-------------------------------------------------|-----------------------------------------------------|
|        | ENO:=SCL(EN,s1,s2,d);<br>ENO:=SCLP(EN,s1,s2,d); | ENO:=SCL_U(EN,s1,s2,d);<br>ENO:=SCLP_U(EN,s1,s2,d); |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction    | Execution condition |
|----------------|---------------------|
| SCL<br>SCL_U   |                     |
| SCLP<br>SCLP_U |                     |

## Setting data

## Description, range, data type

| Operand | Description         | Range                         | Data type                                                                  | Data type (label)                              |
|---------|---------------------|-------------------------------|----------------------------------------------------------------------------|------------------------------------------------|
| (s1)    | SCL(P)<br>SCL(P)_U  | -32768 to 32767<br>0 to 65535 | 16-bit signed binary<br>16-bit unsigned binary                             | ANY16_S<br>ANY16_U                             |
| (s2)    | SCL(P)<br>SCL(P)_U  | —                             | 16-bit signed binary <sup>*1</sup><br>16-bit unsigned binary <sup>*1</sup> | ANY16_S <sup>*2</sup><br>ANY16_U <sup>*2</sup> |
| (d)     | SCL(P)<br>SCL(P)_U  | —                             | 16-bit signed binary<br>16-bit unsigned binary                             | ANY16_S<br>ANY16_U                             |
| EN      | Execution condition | —                             | Bit                                                                        | BOOL                                           |
| ENO     | Execution result    | —                             | Bit                                                                        | BOOL                                           |

\*1 The number of coordinate points in (s2) is represented in 16-bit unsigned binary.

\*2 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

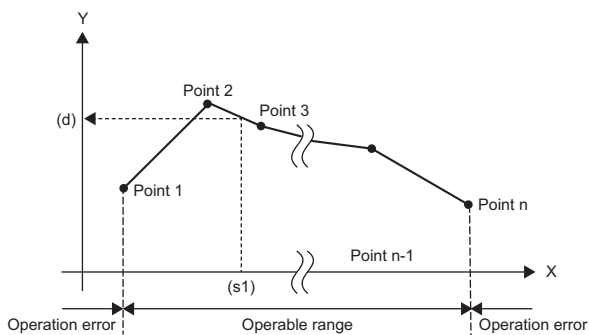
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions scale the scaling conversion data (16-bit data) in the device specified by (s2) on the basis of the input value in the device specified by (s1), and stores the operation result in the device specified by (d). Scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later.

| Setting item (n is the number of coordinate points specified by (s2).) |              | Device assignment |
|------------------------------------------------------------------------|--------------|-------------------|
| Number of coordinate points                                            |              | (s2)              |
| Point 1                                                                | X coordinate | (s2)+1            |
|                                                                        | Y coordinate | (s2)+2            |
| Point 2                                                                | X coordinate | (s2)+3            |
|                                                                        | Y coordinate | (s2)+4            |
| ⋮                                                                      |              |                   |
| Point n                                                                | X coordinate | (s2)+2n-1         |
|                                                                        | Y coordinate | (s2)+2n           |



- If the operation result is not an integer, the first decimal place is rounded off.
- Set the X coordinate data of the scaling conversion data in ascending order.
- Set the value in (s1) within the range of the scaling conversion data (device value in (s2)).
- If two or more points indicate the same X coordinate, the Y coordinate value of the largest point number is output.
- Specify a value from 1 to 65535 for the number of coordinate points of the scaling conversion data specified by (s2).

## Precautions

- The search method and the number of searches vary depending on whether SM755 is on or off.

| SM755 | Search method     | Number of searches                            |
|-------|-------------------|-----------------------------------------------|
| Off   | Sequential search | $1 \leq \text{number of searches} \leq 65535$ |
| On    | Binary search     | $1 \leq \text{number of searches} \leq 16$    |

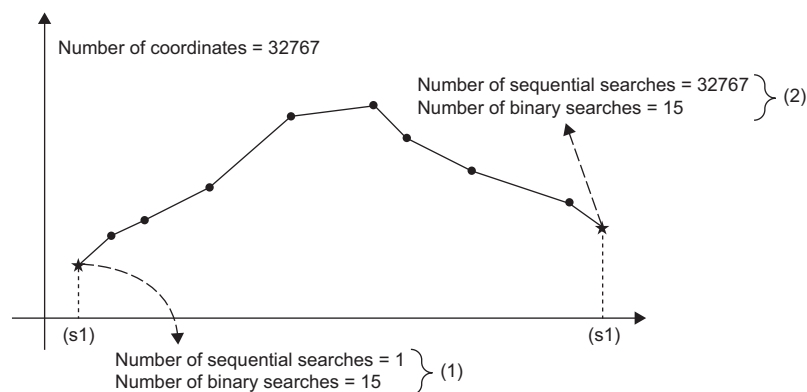
- When the scaling conversion data is sorted in ascending order, the search method varies depending on the status of SM755 and therefore the processing speed also varies. The processing speed depends on the number of searches and is faster as the number of searches is less.

- Case in which the processing speed of sequential search is faster

When the coordinate point specified by (s1) is one from 1 to 15 while the number of coordinate points is the maximum, the number of sequential searches is equal to or less than 15 and therefore the processing speed of the sequential search becomes faster.

- Case in which the processing speed of binary search is faster

The maximum number of searches is 16 and therefore when coordinate point 17 or later is specified by (s1), the number of binary searches is equal to or less than the number of sequential searches, and accordingly the processing speed of the binary search becomes faster.



- (1) The processing speed of the sequential search is faster because the number of sequential searches is less than the number of binary searches.  
 (2) The processing speed of the binary search is faster because the number of binary searches is less than the number of sequential searches.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                           |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | The X-coordinate data of the scaling conversion data before the point specified by (s1) is not sorted in ascending order.<br>(Note that this error is not detected when SM755 is on.) |
|                  | The input value specified by (s1) is out of the range of the specified scaling conversion data.                                                                                       |
|                  | The number of coordinate points starting from the device specified by (s2) is out of the range, 1 to 65535.                                                                           |



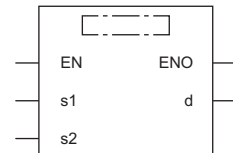
## Scaling 32-bit binary data (point coordinates)

### DSCL(P)(\_U)

These instructions scale the scaling conversion data (32-bit data) on the basis of the specified input value (point coordinates).

| Ladder | ST                                                |                                                       |
|--------|---------------------------------------------------|-------------------------------------------------------|
|        | ENO:=DSCL(EN,s1,s2,d);<br>ENO:=DSCLP(EN,s1,s2,d); | ENO:=DSCL_U(EN,s1,s2,d);<br>ENO:=DSCLP_U(EN,s1,s2,d); |

### FBD/LD



### Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| DSCL<br>DSCL_U   |                     |
| DSCLP<br>DSCLP_U |                     |

### Setting data

### Description, range, data type

| Operand |           | Description                                                             | Range                     | Data type                            | Data type (label)     |
|---------|-----------|-------------------------------------------------------------------------|---------------------------|--------------------------------------|-----------------------|
| (s1)    | DSCL(P)   | Input value to be scaled or the start device containing the input value | -2147483648 to 2147483647 | 32-bit signed binary                 | ANY32_S               |
|         | DSCL(P)_U |                                                                         | 0 to 4294967295           | 32-bit unsigned binary               | ANY32_U               |
| (s2)    | DSCL(P)   | Start device containing scaling conversion data                         | —                         | 32-bit signed binary <sup>*1</sup>   | ANY32_S <sup>*2</sup> |
|         | DSCL(P)_U |                                                                         |                           | 32-bit unsigned binary <sup>*1</sup> | ANY32_U <sup>*2</sup> |
| (d)     | DSCL(P)   | Start device for storing the output value controlled by scaling         | —                         | 32-bit signed binary                 | ANY32_S               |
|         | DSCL(P)_U |                                                                         |                           | 32-bit unsigned binary               | ANY32_U               |
| EN      |           | Execution condition                                                     | —                         | Bit                                  | BOOL                  |
| ENO     |           | Execution result                                                        | —                         | Bit                                  | BOOL                  |

<sup>\*1</sup> The number of coordinate points in (s2)+0 and (s2)+1 is represented in 32-bit unsigned binary.

<sup>\*2</sup> When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

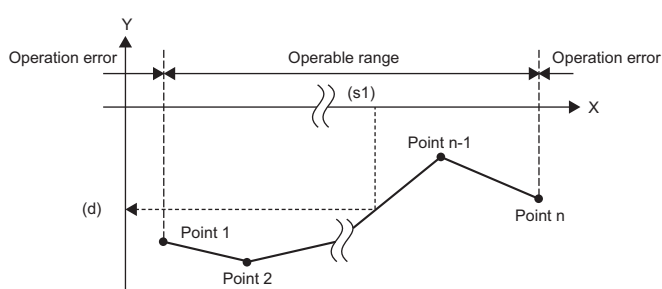
### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions scale the scaling conversion data (32-bit data) in the device specified by (s2) on the basis of the input value in the device specified by (s1), and stores the operation result in the device specified by (d). Scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later.

| Setting item (n is the number of coordinate points specified by (s2).) |              | Device assignment    |
|------------------------------------------------------------------------|--------------|----------------------|
| Number of coordinate points                                            |              | (s2)+1, (s2)         |
| Point 1                                                                | X coordinate | (s2)+3, (s2)+2       |
|                                                                        | Y coordinate | (s2)+5, (s2)+4       |
| Point 2                                                                | X coordinate | (s2)+7, (s2)+6       |
|                                                                        | Y coordinate | (s2)+9, (s2)+8       |
| ⋮                                                                      |              |                      |
| Point n                                                                | X coordinate | (s2)+4n-1, (s2)+4n-2 |
|                                                                        | Y coordinate | (s2)+4n+1, (s2)+4n   |



- If the operation result is not an integer, the first decimal place is rounded off.
- Set the X coordinate data of the scaling conversion data in ascending order.
- Set the value in (s1) within the range of the scaling conversion data (device value in (s2), (s2)+1).
- If two or more points indicate the same X coordinate, the Y coordinate value of the largest point number is output.
- Specify a value from 1 to 4294967295 for the number of coordinate points of the scaling conversion data specified by (s2).

## Precautions

- The search method and the number of searches vary depending on whether SM755 is on or off.

| SM755 | Search method     | Number of searches                                 |
|-------|-------------------|----------------------------------------------------|
| Off   | Sequential search | $1 \leq \text{number of searches} \leq 4294967295$ |
| On    | Binary search     | $1 \leq \text{number of searches} \leq 32$         |

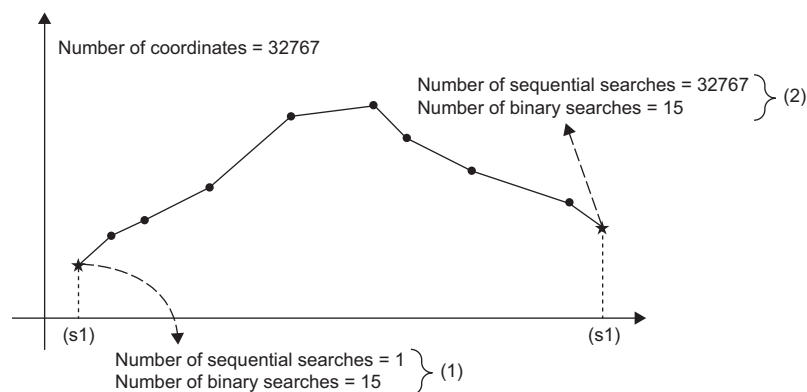
- When the scaling conversion data is sorted in ascending order, the search method varies depending on the status of SM755 and therefore the processing speed also varies. The processing speed depends on the number of searches and is faster as the number of searches is less.

- Case in which the processing speed of sequential search is faster

When the coordinate point specified by (s1) is one from 1 to 15 while the number of coordinate points is the maximum, the number of sequential searches is equal to or less than 15 and therefore the processing speed of the sequential search becomes faster.

- Case in which the processing speed of binary search is faster

The maximum number of searches is 32 and therefore when coordinate point 33 or later is specified by (s1), the number of binary searches is equal to or less than the number of sequential searches, and accordingly the processing speed of the binary search becomes faster.



- (1) The processing speed of the sequential search is faster because the number of sequential searches is less than the number of binary searches.  
 (2) The processing speed of the binary search is faster because the number of binary searches is less than the number of sequential searches.

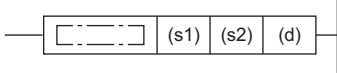
## Operation error

| Error code (SD0) | Description                                                                                                                                                                           |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | The X-coordinate data of the scaling conversion data before the point specified by (s1) is not sorted in ascending order.<br>(Note that this error is not detected when SM755 is on.) |
|                  | The input value specified by (s1) is out of the range of the specified scaling conversion data.                                                                                       |
|                  | The number of coordinate points starting from the device specified by (s2) is out of the range, 1 to 4294967295.                                                                      |

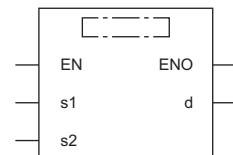
## Scaling 16-bit binary data (XY coordinates)

### SCL2(P)(\_U)

These instructions scale the scaling conversion data (16-bit data) on the basis of the specified input value (XY coordinates).

| Ladder                                                                            | ST                                                |                                                       |
|-----------------------------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------|
|  | ENO:=SCL2(EN,s1,s2,d);<br>ENO:=SCL2P(EN,s1,s2,d); | ENO:=SCL2_U(EN,s1,s2,d);<br>ENO:=SCL2P_U(EN,s1,s2,d); |

### FBD/LD



### ■Execution condition

| Instruction      | Execution condition                                                               |
|------------------|-----------------------------------------------------------------------------------|
| SCL2<br>SCL2_U   |  |
| SCL2P<br>SCL2P_U |  |

### Setting data

### ■Description, range, data type

| Operand | Description          | Range           | Data type                            | Data type (label)     |
|---------|----------------------|-----------------|--------------------------------------|-----------------------|
| (s1)    | SCL2(P)<br>SCL2(P)_U | -32768 to 32767 | 16-bit signed binary                 | ANY16_S               |
|         |                      | 0 to 65535      | 16-bit unsigned binary               | ANY16_U               |
| (s2)    | SCL2(P)<br>SCL2(P)_U | —               | 16-bit signed binary <sup>*1</sup>   | ANY16_S <sup>*2</sup> |
|         |                      |                 | 16-bit unsigned binary <sup>*1</sup> | ANY16_U <sup>*2</sup> |
| (d)     | SCL2(P)<br>SCL2(P)_U | —               | 16-bit signed binary                 | ANY16_S               |
|         |                      |                 | 16-bit unsigned binary               | ANY16_U               |
| EN      | Execution condition  | —               | Bit                                  | BOOL                  |
| ENO     | Execution result     | —               | Bit                                  | BOOL                  |

\*1 The number of coordinate points in (s2) is represented in 16-bit unsigned binary.

\*2 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

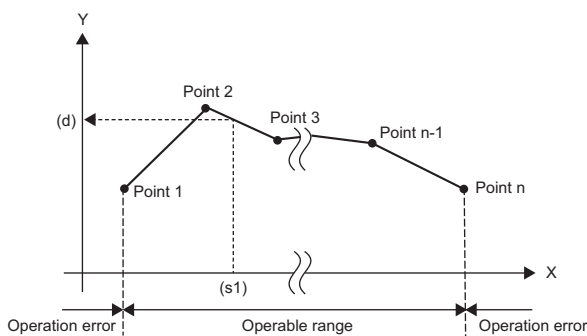
### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions scale the scaling conversion data (16-bit data) in the device specified by (s2) on the basis of the input value in the device specified by (s1), and stores the operation result in the device specified by (d). Scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later.

| Setting item (n is the number of coordinate points specified by (s2).) |         | Device assignment |
|------------------------------------------------------------------------|---------|-------------------|
| Number of coordinate points                                            |         | (s2)              |
| X coordinate                                                           | Point 1 | (s2)+1            |
|                                                                        | Point 2 | (s2)+2            |
|                                                                        | ⋮       | ⋮                 |
|                                                                        | Point n | (s2)+n            |
| Y coordinate                                                           | Point 1 | (s2)+n+1          |
|                                                                        | Point 2 | (s2)+n+2          |
|                                                                        | ⋮       | ⋮                 |
|                                                                        | Point n | (s2)+2n           |



- If the operation result is not an integer, the first decimal place is rounded off.
- Set the X coordinate data of the scaling conversion data in ascending order.
- Set the value in (s1) within the range of the scaling conversion data (device value in (s2)).
- If two or more points indicate the same X coordinate, the Y coordinate value of the largest point number is output.
- Specify a value from 1 to 65535 for the number of coordinate points of the scaling conversion data.

## Precautions

When the scaling conversion data is sorted in ascending order, the search method varies depending on the status of SM755 and therefore the processing speed also varies. For details, refer to the SCL(P)(\_U) instruction.

📖 Page 676 SCL(P)(\_U)

## Operation error

| Error code (SD0) | Description                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------------------|
| 3285H            | The X-coordinate data is not sorted in ascending order.                                                     |
|                  | The input value specified by (s1) is out of the range of the specified scaling conversion data.             |
|                  | The number of coordinate points starting from the device specified by (s2) is out of the range, 1 to 65535. |

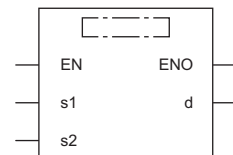
## Scaling 32-bit binary data (XY coordinates)

### DSCL2(P)(\_U)

These instructions scale the scaling conversion data (32-bit data) on the basis of the specified input value (XY coordinates).

| Ladder | ST                                                  |                                                         |
|--------|-----------------------------------------------------|---------------------------------------------------------|
|        | ENO:=DSCL2(EN,s1,s2,d);<br>ENO:=DSCL2P(EN,s1,s2,d); | ENO:=DSCL2_U(EN,s1,s2,d);<br>ENO:=DSCL2P_U(EN,s1,s2,d); |

### FBD/LD



### ■Execution condition

| Instruction        | Execution condition |
|--------------------|---------------------|
| DSCL2<br>DSCL2_U   |                     |
| DSCL2P<br>DSCL2P_U |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                                                                         | Range                     | Data type                            | Data type (label)     |
|---------|-------------------------------------------------------------------------------------|---------------------------|--------------------------------------|-----------------------|
| (s1)    | DSCL2(P)<br>Input value to be scaled or the start device containing the input value | -2147483648 to 2147483647 | 32-bit signed binary                 | ANY32_S               |
|         |                                                                                     | 0 to 4294967295           | 32-bit unsigned binary               | ANY32_U               |
| (s2)    | DSCL2(P)<br>Start device containing scaling conversion data                         | —                         | 32-bit signed binary <sup>*1</sup>   | ANY32_S <sup>*2</sup> |
|         |                                                                                     |                           | 32-bit unsigned binary <sup>*1</sup> | ANY32_U <sup>*2</sup> |
| (d)     | DSCL2(P)<br>Start device for storing the output value controlled by scaling         | —                         | 32-bit signed binary                 | ANY32_S               |
|         |                                                                                     |                           | 32-bit unsigned binary               | ANY32_U               |
| EN      | Execution condition                                                                 | —                         | Bit                                  | BOOL                  |
| ENO     | Execution result                                                                    | —                         | Bit                                  | BOOL                  |

\*1 The number of coordinate points in (s2) to (s2)+1 is represented in 32-bit unsigned binary.

\*2 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

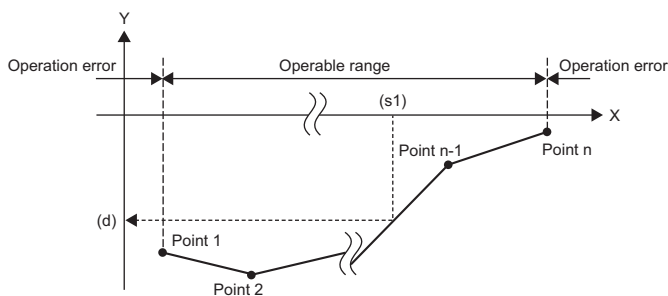
### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions scale the scaling conversion data (32-bit data) in the device specified by (s2) on the basis of the input value in the device specified by (s1), and stores the operation result in the device specified by (d). Scaling conversion is performed based on the scaling conversion data stored in the device specified by (s2) and later.

| Setting item (n is the number of coordinate points specified by (s2).) |         | Device assignment    |
|------------------------------------------------------------------------|---------|----------------------|
| Number of coordinate points                                            |         | (s2)+1, (s2)         |
| X coordinate                                                           | Point 1 | (s2)+3, (s2)+2       |
|                                                                        | Point 2 | (s2)+5, (s2)+4       |
|                                                                        | ⋮       | ⋮                    |
|                                                                        | Point n | (s2)+2n+1, (s2)+2n   |
| Y coordinate                                                           | Point 1 | (s2)+2n+3, (s2)+2n+2 |
|                                                                        | Point 2 | (s2)+2n+5, (s2)+2n+4 |
|                                                                        | ⋮       | ⋮                    |
|                                                                        | Point n | (s2)+4n+1, (s2)+4n   |



- If the operation result is not an integer, the first decimal place is rounded off.
- Set the X coordinate data of the scaling conversion data in ascending order.
- Set the value in (s1) within the range of the scaling conversion data (device value in (s2) to (s2)+1).
- If two or more points indicate the same X coordinate, the Y coordinate value of the largest point number is output.
- Specify a value from 1 to 4294967295 for the number of coordinate points of the scaling conversion data.

## Precautions

When the scaling conversion data is sorted in ascending order, the search method varies depending on the status of SM755 and therefore the processing speed also varies. For details, refer to the DSCL(P)(U) instruction.

📖 Page 679 DSCL(P)(U)

## Operation error

| Error code (SD0) | Description                                                                                                      |
|------------------|------------------------------------------------------------------------------------------------------------------|
| 3285H            | The X-coordinate data is not sorted in ascending order.                                                          |
|                  | The input value specified by (s1) is out of the range of the specified scaling conversion data.                  |
|                  | The number of coordinate points starting from the device specified by (s2) is out of the range, 1 to 4294967295. |

# 14.6 Data Processing Instructions

## Searching 16-bit binary data

### SERDATA(P)

These instructions search the (n) points in the 16-bit binary data specified by (s2) for the 16-bit binary data specified by (s1).

| Ladder | ST                                                                  |
|--------|---------------------------------------------------------------------|
|        | <pre>ENO:=SERDATA(EN,s1,s2,n,d); ENO:=SERDATAP(EN,s1,s2,n,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SERDATA     |                     |
| SERDATAP    |                     |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                          | Range           | Data type              | Data type (label)                      |
|---------|------------------------------------------------------|-----------------|------------------------|----------------------------------------|
| (s1)    | Search data or the device containing the search data | -32768 to 32767 | 16-bit signed binary   | ANY16                                  |
| (s2)    | Start device where the search target data is stored  | —               | 16-bit signed binary   | ANY16 <sup>*1</sup>                    |
| (d)     | Start device for storing the search result           | —               | 16-bit signed binary   | ANY16_ARRAY<br>(Number of elements: 2) |
| (n)     | Number of search target data points                  | 0 to 65535      | 16-bit unsigned binary | ANY16                                  |
| EN      | Execution condition                                  | —               | Bit                    | BOOL                                   |
| ENO     | Execution result                                     | —               | Bit                    | BOOL                                   |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

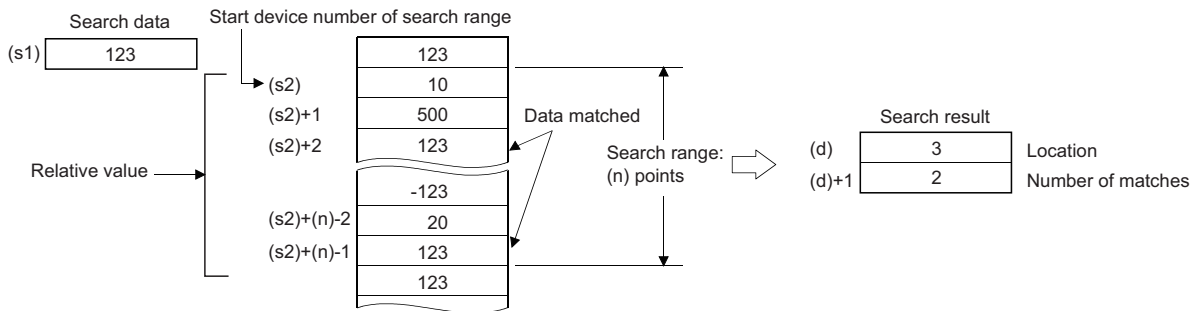
### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |



## Processing details

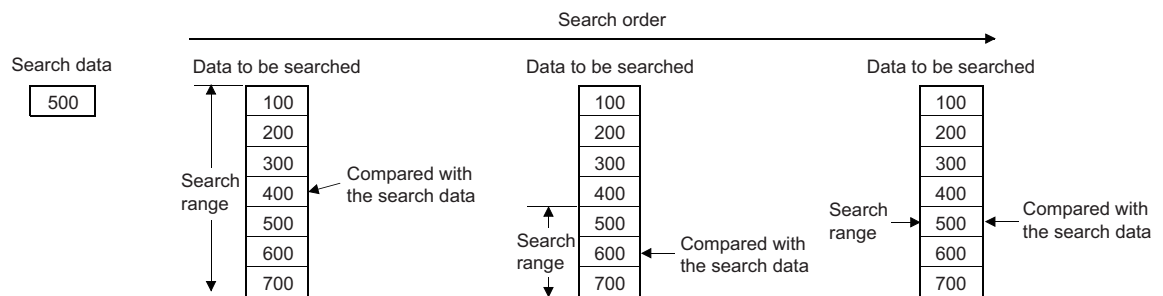
- These instructions search the (n) points in units of 16-bit binary data from the device specified by (s2) using the 16-bit binary data in the device specified by (s1) as a keyword. Each instruction stores the number of data which matches the keyword in the device specified by (d)+1 and also stores the relative value of the first-matched device number from (s2) in the device specified by (d).



- If the value specified by (n) is 0, no processing is performed.
- If no matching data is found as the result of search, 0 is stored in the devices specified by (d) and (d)+1.

### Point

- If the data to be searched by the SERDATA(P) instruction has been sorted in ascending order, turning on SM702<sup>\*1</sup> enables a binary search which can process the search faster. If SM702 is turned on even though the data to be search has not been sorted in ascending order, normal search results cannot be obtained. The following figure shows an example of binary search.



<sup>\*1</sup> SM702 is a special relay for setting the search method.

SM702 is off: Sequential search (linear search)

This method compares the search data with the data to be searched for starting from the start of data

SM702 is on: Binary search

For the data that has been sorted in ascending order, this method checks the center value of the search range, determining whether the center value is larger or smaller than the search value, and thereby narrows the search range to either side. Thus, target data is searched for by repeating this processing.

## Operation error

There is no operation error.

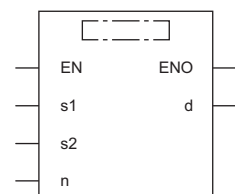
# Searching 32-bit binary data

## DSERDATA(P)

These instructions search the (n) points in the 32-bit binary data specified by (s2) for the 32-bit binary data specified by (s1).

| Ladder | ST                                                                    |
|--------|-----------------------------------------------------------------------|
|        | <pre>ENO:=DSERDATA(EN,s1,s2,n,d); ENO:=DSERDATAP(EN,s1,s2,n,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DSERDATA    |                     |
| DSERDATAP   |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                | Range                     | Data type              | Data type (label)                      |
|---------|------------------------------------------------------------|---------------------------|------------------------|----------------------------------------|
| (s1)    | Search data or the start device containing the search data | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32                                  |
| (s2)    | Start device where the search target data is stored        | —                         | 32-bit signed binary   | ANY32 <sup>*1</sup>                    |
| (d)     | Start device for storing the search result                 | —                         | 16-bit signed binary   | ANY16_ARRAY<br>(Number of elements: 2) |
| (n)     | Number of search target data points                        | 0 to 65535                | 16-bit unsigned binary | ANY16                                  |
| EN      | Execution condition                                        | —                         | Bit                    | BOOL                                   |
| ENO     | Execution result                                           | —                         | Bit                    | BOOL                                   |

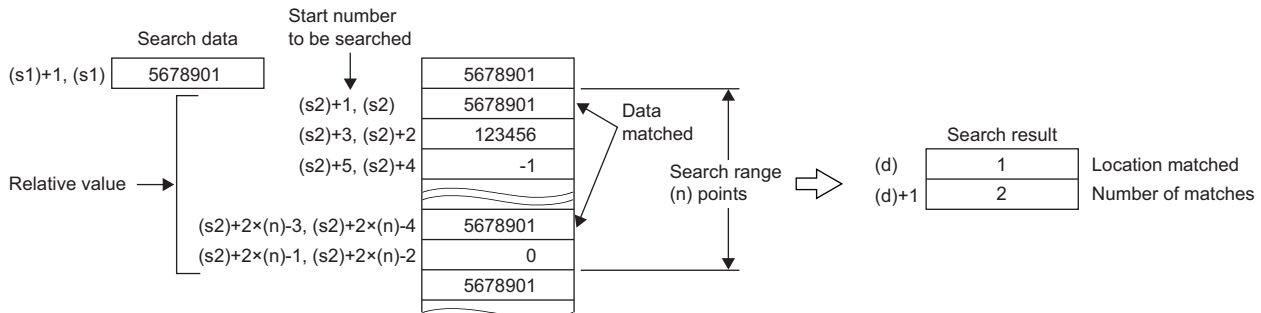
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

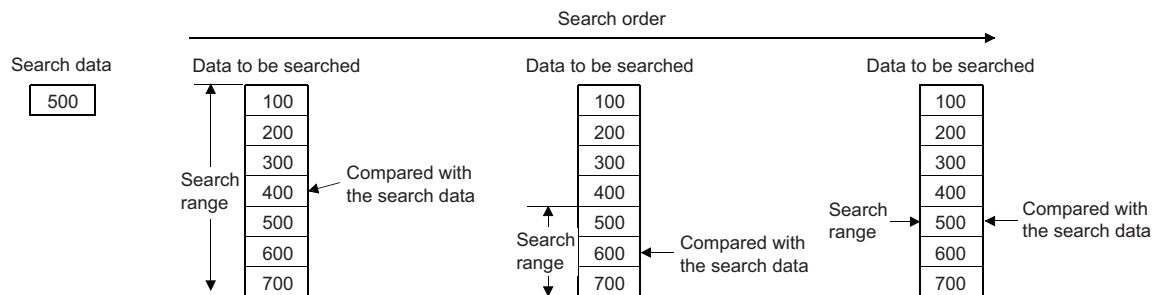
- These instructions search the (n) points of data in units of 32-bit binary data ( $2 \times (n)$  points of data in units of 16 bits) from the device specified by (s2), using the 32-bit binary data in the device specified by (s1) as a keyword. Each instruction stores the number of data which matches the keyword in the device specified by (d)+1 and also stores the relative value of the first-matched device number from (s2) in the device specified by (d).



- If the value specified by (n) is 0, no processing is performed.
- If no matching data is found as the result of search, 0 is stored in the devices specified by (d) and (d)+1.

## Point

- If the data to be searched by the DSERDATA(P) instruction has been sorted in ascending order, turning on SM702<sup>\*1</sup> enables a binary search which can process the search faster. If SM702 is turned on even though the data to be search has not been sorted in ascending order, normal search results cannot be obtained. The following figure shows an example of binary search.



<sup>\*1</sup> SM702 is a special relay for setting the search method.

SM702 is off: Sequential search (linear search)

This method compares the search data with the data to be searched for starting from the start of data

SM702 is on: Binary search

For the data that has been sorted in ascending order, this method checks the center value of the search range, determining whether the center value is larger or smaller than the search value, and thereby narrows the search range to either side. Thus, target data is searched for by repeating this processing.

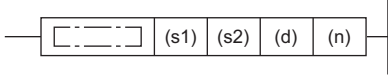
## Operation error

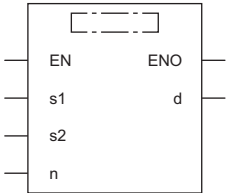
There is no operation error.

# Searching 16-bit binary data (minimum, match, maximum)

## SERMM(P)

These instructions search the (n) points in the 16-bit binary data specified by (s1) for the same data as the 16-bit binary data specified by (s2), the minimum value, and the maximum value.

| Ladder                                                                            | ST                                                              |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------|
|  | <pre>ENO:=SERMM(EN,s1,s2,n,d); ENO:=SERMMP(EN,s1,s2,n,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| SERMM       |   |
| SERMMP      |  |

### Setting data

### Description, range, data type

| Operand | Description                                                                                       | Range      | Data type              | Data type (label)                      |
|---------|---------------------------------------------------------------------------------------------------|------------|------------------------|----------------------------------------|
| (s1)    | Start device in which the same data, maximum value, and minimum value are searched                | —          | 16-bit signed binary   | ANY16                                  |
| (s2)    | Data to be searched for or device storing data                                                    | —          | 16-bit signed binary   | ANY16                                  |
| (d)     | Start device storing number of the same data, maximum value, and minimum value detected by search | —          | 16-bit unsigned binary | ANY16_ARRAY<br>(Number of elements: 5) |
| (n)     | Number of data in which the same data, maximum value, and minimum value are searched              | 0 to 65535 | 16-bit unsigned binary | ANY16_U                                |
| EN      | Execution condition                                                                               | —          | Bit                    | BOOL                                   |
| ENO     | Execution result                                                                                  | —          | Bit                    | BOOL                                   |

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   |             | Double word |      | Indirect specification | Constant |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|-------------|------|------------------------|----------|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |        |
| (s1)    | —                                | —   | ○                                     | —           | — | —           | —           | ○    | —                      | —        | —  | — |        |
| (s2)    | ○ <sup>*1</sup>                  | ○   | ○                                     | ○           | ○ | —           | —           | ○    | ○                      | —        | —  | — |        |
| (d)     | —                                | —   | ○                                     | ○           | — | —           | —           | ○    | —                      | —        | —  | — |        |
| (n)     | ○ <sup>*1</sup>                  | ○   | ○                                     | ○           | ○ | —           | —           | ○    | ○                      | —        | —  | — |        |

\*1 FX and FY cannot be used.

## Processing details

- These instructions search the same data as the 16-bit binary data of (s2) in (n) data starting from (s1), and store the search result in (d) to (d)+4.
- When the same data exists, five devices starting from (d) store the number of the same data, first and last positions of the same data, maximum value position, and minimum value position.
- When the same data does not exist, five devices starting from (d) store the number of the same data, first and last positions of the same data, maximum value position, and minimum value position. In this case, however, 0s are stored in three devices starting from (d) (which store the number of the same data, first and last positions of the same data).
- When there are two or more maximum or minimum values in the searched data, the last position of the maximum/minimum values is stored.
- If the value specified by (n) is 0, no processing is performed.
- The following table shows example of configuration of search result table and data. (n=10)

| Searched device (s1) | Searched data (s1) value (example) | Comparison data (s2) value (example) | Data position | Search result       |                    |                     |
|----------------------|------------------------------------|--------------------------------------|---------------|---------------------|--------------------|---------------------|
|                      |                                    |                                      |               | Maximum value (d)+4 | Match (d)          | Minimum value (d)+3 |
| (s1)                 | 100                                | 100                                  | 0             | —                   | ○ (First position) | —                   |
| (s1)+1               | 111                                |                                      | 1             | —                   | —                  | —                   |
| (s1)+2               | 100                                |                                      | 2             | —                   | ○                  | —                   |
| (s1)+3               | 98                                 |                                      | 3             | —                   | —                  | —                   |
| (s1)+4               | 123                                |                                      | 4             | —                   | —                  | —                   |
| (s1)+5               | 66                                 |                                      | 5             | —                   | —                  | ○                   |
| (s1)+6               | 100                                |                                      | 6             | —                   | ○ (Last position)  | —                   |
| (s1)+7               | 95                                 |                                      | 7             | —                   | —                  | —                   |
| (s1)+8               | 210                                |                                      | 8             | ○                   | —                  | —                   |
| (s1)+9               | 88                                 |                                      | 9             | —                   | —                  | —                   |

- The following table shows the search result table obtained by the above example.

| Device number | Description | Search result item                         |
|---------------|-------------|--------------------------------------------|
| (d)           | 3           | Number of the same data                    |
| (d)+1         | 0           | Position of the same data (first position) |
| (d)+2         | 6           | Position of the same data (last position)  |
| (d)+3         | 5           | Minimum value position (last position)     |
| (d)+4         | 8           | Maximum value position (last position)     |

## Operation error

There is no operation error.

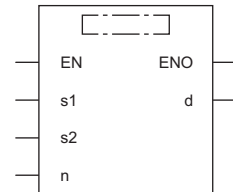
# Searching 32-bit binary data (minimum, match, maximum)

## DSERMM(P)

These instructions search the (n) points in the 32-bit binary data specified by (s1) for the same data as the 32-bit binary data specified by (s2), the minimum value, and the maximum value.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | ENO:=DSERMM(EN,s1,s2,n,d);<br>ENO:=DSERMMP(EN,s1,s2,n,d); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DSERMM      |                     |
| DSERMMP     |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                                       | Range      | Data type              | Data type (label)                      |
|---------|---------------------------------------------------------------------------------------------------|------------|------------------------|----------------------------------------|
| (s1)    | Start device in which the same data, maximum value, and minimum value are searched                | —          | 32-bit signed binary   | ANY32                                  |
| (s2)    | Data to be searched for or device storing data                                                    | —          | 32-bit signed binary   | ANY32                                  |
| (d)     | Start device storing number of the same data, maximum value, and minimum value detected by search | —          | 32-bit unsigned binary | ANY32_ARRAY<br>(Number of elements: 5) |
| (n)     | Number of data in which the same data, maximum value, and minimum value are searched              | 0 to 65535 | 16-bit unsigned binary | ANY16_U                                |
| EN      | Execution condition                                                                               | —          | Bit                    | BOOL                                   |
| ENO     | Execution result                                                                                  | —          | Bit                    | BOOL                                   |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | ○*1                              | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○*1                              | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

\*1 FX and FY cannot be used.

## Processing details

- These instructions search the same data as the 32-bit binary data of (s2)+1 and (s2) in (n) data starting from (s1)+1 and (s1), and store the search result in [(d)+1, (d)] to [(d)+9, (d)+8].
- When the same data exists, five devices starting from (d)+1 and (d) store the number of the same data, first and last positions of the same data, maximum value position, and minimum value position.
- When the same data does not exist, five devices starting from (d)+1 and (d) store the number of the same data, first and last positions of the same data, maximum value position and minimum value position. In this case, however, 0s are stored in three devices starting from (d)+1 and (d) (which store the number of the same data, first and last positions of the same data).
- When there are two or more maximum or minimum values in the searched data, the last position of the maximum/minimum values is stored.
- If the value specified by (n) is 0, no processing is performed.
- The following table shows example of configuration of search result table and data. (n=10)

| Searched device (s1) | Searched data (s1) value (example) | Comparison data (s2) value (example) | Data position | Search result              |                    |                            |
|----------------------|------------------------------------|--------------------------------------|---------------|----------------------------|--------------------|----------------------------|
|                      |                                    |                                      |               | Maximum value (d)+9, (d)+8 | Match (d)          | Minimum value (d)+7, (d)+6 |
| (s1)+1, (s1)         | 100000                             | 100000                               | 0             | —                          | ○ (First position) | —                          |
| (s1)+3, (s1)+2       | 110100                             |                                      | 1             | —                          | —                  | —                          |
| (s1)+5, (s1)+4       | 100000                             |                                      | 2             | —                          | ○                  | —                          |
| (s1)+7, (s1)+6       | 98000                              |                                      | 3             | —                          | —                  | —                          |
| (s1)+9, (s1)+8       | 123000                             |                                      | 4             | —                          | —                  | —                          |
| (s1)+11, (s1)+10     | 66000                              |                                      | 5             | —                          | —                  | ○                          |
| (s1)+13, (s1)+12     | 100000                             |                                      | 6             | —                          | ○ (Last position)  | —                          |
| (s1)+15, (s1)+14     | 95000                              |                                      | 7             | —                          | —                  | —                          |
| (s1)+17, (s1)+16     | 910000                             |                                      | 8             | ○                          | —                  | —                          |
| (s1)+19, (s1)+18     | 910000                             |                                      | 9             | ○                          | —                  | —                          |

- The following table shows the search result table obtained by the above example.

| Device number | Description | Search result item                         |
|---------------|-------------|--------------------------------------------|
| (d)+1, (d)    | 3           | Number of the same data                    |
| (d)+3, (d)+2  | 0           | Position of the same data (first position) |
| (d)+5, (d)+4  | 6           | Position of the same data (last position)  |
| (d)+7, (d)+6  | 5           | Minimum value position (last position)     |
| (d)+9, (d)+8  | 9           | Maximum value position (last position)     |

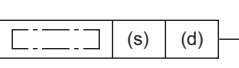
## Operation error

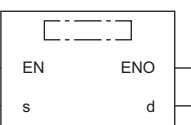
There is no operation error.

# Checking 16-bit binary data

## SUM(P)

These instructions store the total number of "1" bits in the 16-bit binary data stored in the specified device.

| Ladder                                                                            | ST                                      |
|-----------------------------------------------------------------------------------|-----------------------------------------|
|  | ENO:=SUM(EN,s,d);<br>ENO:=SUMP(EN,s,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| SUM         |  |
| SUMP        |  |

### Setting data

### Descriptions, ranges, and data types

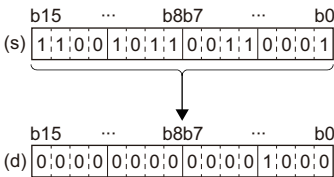
| Operand | Description                                                                   | Range           | Data type            | Data type (label) |
|---------|-------------------------------------------------------------------------------|-----------------|----------------------|-------------------|
| (s)     | Device containing data in which the total number of "1" bits is to be counted | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Device for storing the total number of bits                                   | —               | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                           | —               | Bit                  | BOOL              |
| ENO     | Execution result                                                              | —               | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Processing details

These instructions store the total number of "1" bits in the 16-bit binary data, which is stored in the device specified by (s), in the device specified by (d).



The total number of 1s is stored in binary. (Eight 1s in the left example)

### Operation error

There is no operation error.



## Checking 32-bit binary data

### DSUM(P)

These instructions store the total number of "1" bits in the 32-bit binary data stored in the specified device.

| Ladder | ST                                        |
|--------|-------------------------------------------|
|        | ENO:=DSUM(EN,s,d);<br>ENO:=DSUMP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DSUM        |                     |
| DSUMP       |                     |

### Setting data

### Descriptions, ranges, and data types

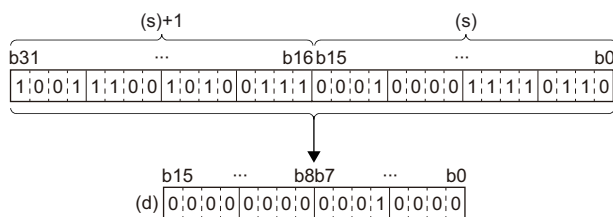
| Operand | Description                                                                         | Range                     | Data type            | Data type (label) |
|---------|-------------------------------------------------------------------------------------|---------------------------|----------------------|-------------------|
| (s)     | Start device containing data in which the total number of "1" bits is to be counted | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)     | Device for storing the total number of bits                                         | —                         | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                                 | —                         | Bit                  | BOOL              |
| ENO     | Execution result                                                                    | —                         | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

### Processing details

These instructions store the total number of "1" bits in the 32-bit binary data, which is stored in the device specified by (s), in the device specified by (d).



The total number of 1s is stored in binary. (Sixteen 1s in the left example)

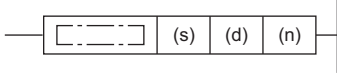
### Operation error

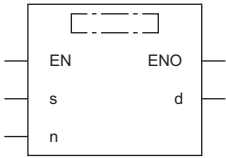
There is no operation error.

# Searching the maximum value of 16-bit binary data

## MAX(P)(\_U)

These instructions search the (n) points of 16-bit binary data in the specified device for the maximum value.

| Ladder                                                                            | ST*1                 |                        |
|-----------------------------------------------------------------------------------|----------------------|------------------------|
|  | ENO:=MAXP(EN,s,n,d); | ENO:=MAXP_U(EN,s,n,d); |

| FBD/LD*1                                                                          |
|-----------------------------------------------------------------------------------|
|  |

\*1 The MAX and MAX\_U instructions do not support the ST and FBD/LD. Use the standard function, MAX.

Page 1360 MAX(\_E), MIN(\_E)

## Execution condition

| Instruction    | Execution condition                                                                |
|----------------|------------------------------------------------------------------------------------|
| MAX<br>MAX_U   |   |
| MAXP<br>MAXP_U |  |

## Setting data

## Description, range, data type

| Operand | Description           | Range      | Data type              | Data type (label)                        |
|---------|-----------------------|------------|------------------------|------------------------------------------|
| (s)     | MAX(P)                | —          | 16-bit signed binary   | ANY16_S*1                                |
|         | MAX(P)_U              |            | 16-bit unsigned binary | ANY16_U*1                                |
| (d)     | MAX(P)                | —          | 16-bit signed binary   | ANY16_S_ARRAY<br>(Number of elements: 3) |
|         | MAX(P)_U              |            | 16-bit unsigned binary | ANY16_U_ARRAY<br>(Number of elements: 3) |
| (n)     | Number of search data | 0 to 65535 | 16-bit unsigned binary | ANY16                                    |
| EN      | Execution condition   | —          | Bit                    | BOOL                                     |
| ENO     | Execution result      | —          | Bit                    | BOOL                                     |

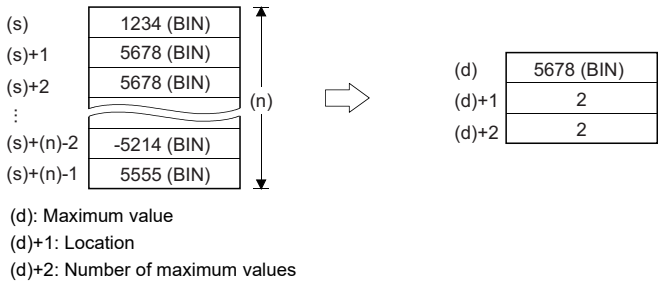
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

### Processing details

These instructions search the (n) points of 16-bit binary data in the device specified by (s) for the maximum value, and store the maximum value in the device specified by (d). Each instruction searches data starting from the device specified by (s) and detects first the maximum value in the xth point from (s), and stores x in (d)+1 and the number of maximum values in (d)+2.



### Operation error

There is no operation error.

# Searching the maximum value of 32-bit binary data

## DMAX(P)(\_U)

These instructions search the (n) points of 32-bit binary data in the specified device for the maximum value.

| Ladder | ST*1                  |                         |
|--------|-----------------------|-------------------------|
|        | ENO:=DMAXP(EN,s,n,d); | ENO:=DMAXP_U(EN,s,n,d); |

| FBD/LD*1 |
|----------|
|          |

\*1 The DMAX and DMAX\_U instructions do not support the ST and FBD/LD. Use the standard function, MAX.

☞ Page 1360 MAX(\_E), MIN(\_E)

## Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| DMAX<br>DMAX_U   |                     |
| DMAXP<br>DMAXP_U |                     |

## Setting data

## Description, range, data type

| Operand | Description           | Range      | Data type              | Data type (label)   |
|---------|-----------------------|------------|------------------------|---------------------|
| (s)     | DMAX(P)               | —          | 32-bit signed binary   | ANY32_S*1           |
|         | DMAX(P)_U             |            | 32-bit unsigned binary | ANY32_U*1           |
| (d)     | DMAX(P)               | —          | 32-bit signed binary   | —*2 (ANY32_S_ARRAY) |
|         | DMAX(P)_U             |            | 32-bit unsigned binary | —*2 (ANY32_U_ARRAY) |
| (n)     | Number of search data | 0 to 65535 | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition   | —          | Bit                    | BOOL                |
| ENO     | Execution result      | —          | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

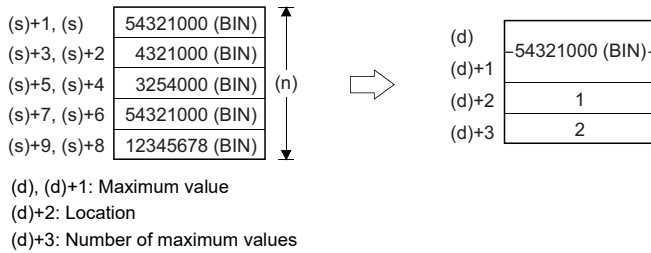
\*2 Specify a device regardless of the programming language used. Do not specify labels.

## Applicable devices

| Operand | Bit                              |      | Word                                  |             | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | —           | —           | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | —           | —           | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○           | —           | ○                      | ○        | — | —  | —      |

## Processing details

These instructions search the (n) points of 32-bit binary data in the device specified by (s) for the maximum value, and store the maximum value in the devices specified by (d) and (d)+1. Each instruction searches data starting from the device specified by (s) and detects first the maximum value in the xth point from (s), and stores x in (d)+2 and the number of maximum values in (d)+3.



## Operation error

There is no operation error.

# Searching the minimum value of 16-bit binary data

## MIN(P)(\_U)

These instructions search the (n) points of 16-bit binary data in the specified device for the minimum value.

| Ladder | ST*1                 |                        |
|--------|----------------------|------------------------|
|        | ENO:=MINP(EN,s,n,d); | ENO:=MINP_U(EN,s,n,d); |

| FBD/LD*1 |
|----------|
|          |

\*1 The MIN and MIN\_U instructions do not support the ST and FBD/LD. Use the standard function, MIN.

Page 1360 MAX(\_E), MIN(\_E)

## Execution condition

| Instruction    | Execution condition |
|----------------|---------------------|
| MIN<br>MIN_U   |                     |
| MINP<br>MINP_U |                     |

## Setting data

## Description, range, data type

| Operand | Description           | Range      | Data type              | Data type (label)                        |
|---------|-----------------------|------------|------------------------|------------------------------------------|
| (s)     | MIN(P)                | —          | 16-bit signed binary   | ANY16_S*1                                |
|         | MIN(P)_U              |            | 16-bit unsigned binary | ANY16_U*1                                |
| (d)     | MIN(P)                | —          | 16-bit signed binary   | ANY16_S_ARRAY<br>(Number of elements: 3) |
|         | MIN(P)_U              |            | 16-bit unsigned binary | ANY16_U_ARRAY<br>(Number of elements: 3) |
| (n)     | Number of search data | 0 to 65535 | 16-bit unsigned binary | ANY16                                    |
| EN      | Execution condition   | —          | Bit                    | BOOL                                     |
| ENO     | Execution result      | —          | Bit                    | BOOL                                     |

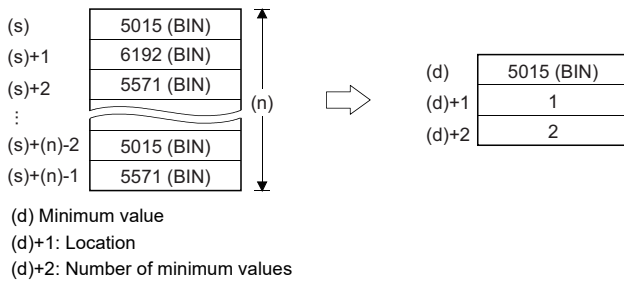
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

These instructions search the (n) points of 16-bit binary data in the device specified by (s) for the minimum value, and store the minimum value in the device specified by (d). Each instruction searches data starting from the device specified by (s) and detects first the minimum value in the xth point from (s), and stores x in (d)+1 and the number of minimum values in (d)+2.



## Operation error

There is no operation error.

# Searching the minimum value of 32-bit binary data

## DMIN(P)(\_U)

These instructions search the (n) points of 32-bit binary data in the specified device for the minimum value.

| Ladder | ST*1                  |                         |
|--------|-----------------------|-------------------------|
|        | ENO:=DMINP(EN,s,n,d); | ENO:=DMINP_U(EN,s,n,d); |

| FBD/LD*1 |
|----------|
|          |

\*1 The DMIN and DMIN\_U instructions do not support the ST and FBD/LD. Use the standard function, MIN.

Page 1360 MAX(\_E), MIN(\_E)

## Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| DMIN<br>DMIN_U   |                     |
| DMINP<br>DMINP_U |                     |

## Setting data

## Description, range, data type

| Operand | Description           | Range      | Data type              | Data type (label)   |
|---------|-----------------------|------------|------------------------|---------------------|
| (s)     | DMIN(P)               | —          | 32-bit signed binary   | ANY32_S*1           |
|         | DMIN(P)_U             |            | 32-bit unsigned binary | ANY32_U*1           |
| (d)     | DMIN(P)               | —          | 32-bit signed binary   | —*2 (ANY32_S_ARRAY) |
|         | DMIN(P)_U             |            | 32-bit unsigned binary | —*2 (ANY32_U_ARRAY) |
| (n)     | Number of search data | 0 to 65535 | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition   | —          | Bit                    | BOOL                |
| ENO     | Execution result      | —          | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

\*2 Specify a device regardless of the programming language used. Do not specify labels.

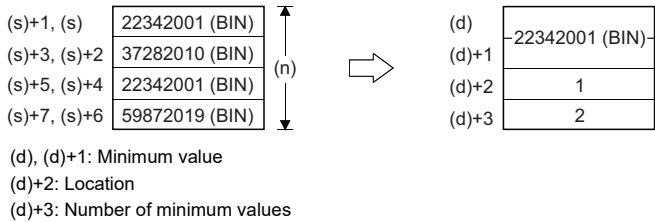
## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |



### Processing details

These instructions search the (n) points of 32-bit binary data in the device specified by (s) for the minimum value, and store the minimum value in the devices specified by (d) and (d)+1. Each instruction searches data starting from the device specified by (s) and detects first the minimum value in the xth point from (s), and stores x in (d)+2 and the number of minimum values in (d)+3.



### Operation error

There is no operation error.

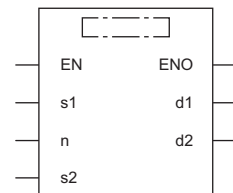
# Sorting 16-bit binary data

## SORTD(\_U)

These instructions sort (n) points of 16-bit binary data in ascending or descending order.

| Ladder | ST                            |                                 |
|--------|-------------------------------|---------------------------------|
|        | ENO:=SORTD(EN,s1,n,s2,d1,d2); | ENO:=SORTD_U(EN,s1,n,s2,d1,d2); |

## FBD/LD



## Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| SORTD<br>SORTD_U |                     |

## Setting data

## Description, range, data type

| Operand    | Description                                                      | Range      | Data type              | Data type (label)                      |
|------------|------------------------------------------------------------------|------------|------------------------|----------------------------------------|
| (s1) SORTD | Start device of the table data to be sorted                      | —          | 16-bit signed binary   | ANY16_S <sup>*1</sup>                  |
| SORTD_U    |                                                                  |            | 16-bit unsigned binary | ANY16_U <sup>*1</sup>                  |
| (n)        | Number of sort data                                              | 0 to 65535 | 16-bit unsigned binary | ANY16                                  |
| (s2)       | Number of data to be compared once                               | 1 to 65535 | 16-bit unsigned binary | ANY16                                  |
| (d1)       | Number of the bit device to be turned on upon completion of sort | —          | Bit                    | ANY_BOOL                               |
| (d2)       | Device used by the system                                        | —          | 16-bit signed binary   | ANY16_ARRAY<br>(Number of elements: 2) |
| EN         | Execution condition                                              | —          | Bit                    | BOOL                                   |
| ENO        | Execution result                                                 | —          | Bit                    | BOOL                                   |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

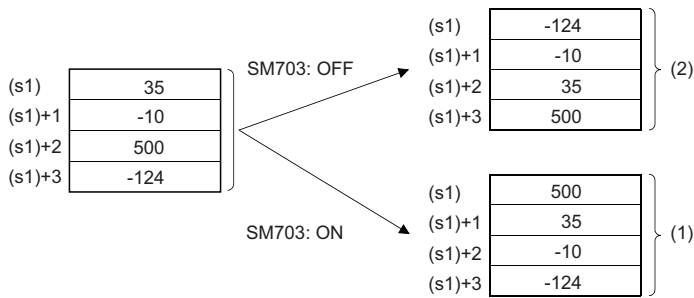
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d1)    | ○                                | —   | ○*1                                   | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |

\*1 T, C, and ST cannot be used.

## Processing details

- These instructions sort (n) points of 16-bit binary data from (s1) in ascending or descending order. Data is sorted in ascending order when SM703 is off and in descending order when SM703 is on.



(1) Data are sorted in descending order.

(2) Data are sorted in ascending order.

- Sorting by the SORTD(\_U) instruction requires several scans. The number of scans required till completion of sorting is determined by dividing the maximum number of executions performed before completion of sorting by the number of data compared once specified by (s2). (The decimal fractions are rounded up.) When the value in (s2) is increased, the number of scans before completion of sorting is decreased but the scan time is increased.
- The maximum number of executions before completion of sorting is calculated by  $(n) \times (n-1) \div 2$  (times). When (n)=10, for example,  $10 \times (10-1) \div 2 = 45$  times. At this time, setting (s2)=2, for example, makes  $45 \div 2 = 22.5$  meaning that 23 scans are required before completion of sorting.
- The completion device specified by (d1) turns off at start of execution of the SORTD(\_U) instruction and turns on upon completion of sorting. After completion of sorting, the device specified by (d1) is kept on. Turn it off as needed.
- The two points from the device specified by (d2) are used by the system at execution of the SORTD(\_U) instruction. Do not change the two points from the device specified by (d2). If they are changed, an error may occur. (Error code: 3285H)
- If the value in (n) is changed during sorting, the new number of sort data is used for sorting.
- If the execution command is turned off during sorting, sorting is interrupted. If the execution command is turned on again, sorting is performed from the beginning.
- If the next sorting is performed continuously after completion of the previous sorting, the execution command needs to be turned off and turned on again.

## Operation error

| Error code (SD0) | Description                                                                                                                                            |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The device range of (n) points from the device specified by (s1) and the device range of two points from the device specified by (d2) are overlapping. |
| 3285H            | The value in (s2) is 0.                                                                                                                                |
|                  | In the second scan or after, the value in (d2) used by the system is equal to or greater than the value in (n).                                        |
|                  | In the second scan or after, the value in (d2) used by the system is $(d2) < (d2)+1$ .                                                                 |

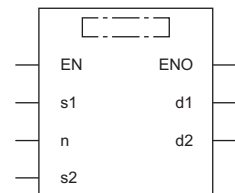
# Sorting 32-bit binary data

## DSORTD(\_U)

These instructions sort (n) points of 32-bit binary data in ascending or descending order.

| Ladder | ST                             |                                  |
|--------|--------------------------------|----------------------------------|
|        | ENO:=DSORTD(EN,s1,n,s2,d1,d2); | ENO:=DSORTD_U(EN,s1,n,s2,d1,d2); |

## FBD/LD



## Execution condition

| Instruction        | Execution condition |
|--------------------|---------------------|
| DSORTD<br>DSORTD_U |                     |

## Setting data

## Description, range, data type

| Operand     | Description                                                      | Range      | Data type              | Data type (label)                      |
|-------------|------------------------------------------------------------------|------------|------------------------|----------------------------------------|
| (s1) DSORTD | Start device of the table data to be sorted                      | —          | 32-bit signed binary   | ANY32_S <sup>*1</sup>                  |
| DSORTD_U    |                                                                  |            | 32-bit unsigned binary | ANY32_U <sup>*1</sup>                  |
| (n)         | Number of sort data                                              | 0 to 65535 | 16-bit unsigned binary | ANY16                                  |
| (s2)        | Number of data to be compared once                               | 1 to 65535 | 16-bit unsigned binary | ANY16                                  |
| (d1)        | Number of the bit device to be turned on upon completion of sort | —          | Bit                    | ANY_BOOL                               |
| (d2)        | Device used by the system                                        | —          | 16-bit signed binary   | ANY16_ARRAY<br>(Number of elements: 2) |
| EN          | Execution condition                                              | —          | Bit                    | BOOL                                   |
| ENO         | Execution result                                                 | —          | Bit                    | BOOL                                   |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

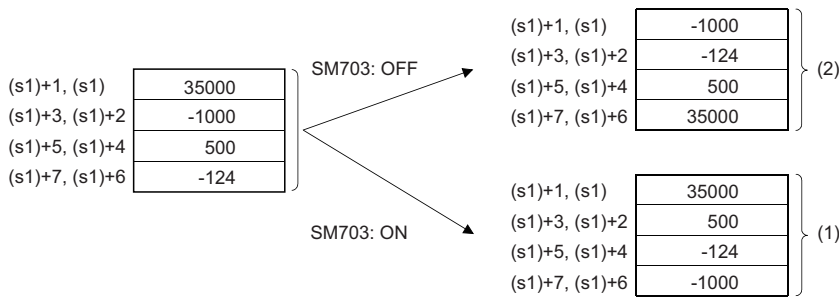
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   |             | Double word |      | Indirect specification | Constant |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|-------------|------|------------------------|----------|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —           | ○    | —                      | —        | —  | — |        |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —           | ○    | ○                      | —        | —  | — |        |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —           | ○    | ○                      | —        | —  | — |        |
| (d1)    | ○                                | —   | ○*1                                   | —          | — | —           | —           | ○    | —                      | —        | —  | — |        |
| (d2)    | —                                | —   | ○                                     | —          | — | —           | —           | ○    | —                      | —        | —  | — |        |

\*1 T, C, and ST cannot be used.

## Processing details

- These instructions sort (n) points of 32-bit binary data from (s1) in ascending or descending order. Data is sorted in ascending order when SM703 is off and in descending order when SM703 is on.



- (1) Data are sorted in descending order.  
 (2) Data are sorted in ascending order.

- Sorting by the DSORTD(\_U) instruction requires several scans. The number of scans required till completion of sorting is determined by dividing the maximum number of executions performed before completion of sorting by the number of data compared once specified by (s2). (The decimal fractions are rounded up.) When the value in (s2) is increased, the number of scans before completion of sorting is decreased but the scan time is increased.
- The maximum number of executions before completion of sorting is calculated by  $(n) \times (n-1) \div 2$  (times). When (n)=10, for example,  $10 \times (10-1) \div 2 = 45$  times. At this time, setting (s2)=2, for example, makes  $45 \div 2 = 22.5$  meaning that 23 scans are required before completion of sorting.
- The completion device specified by (d1) turns off at start of execution of the DSORTD(\_U) instruction and turns on upon completion of sorting. After completion of sorting, the device specified by (d1) is kept on. Turn it off as needed.
- The two points from the device specified by (d2) are used by the system at execution of the DSORTD(\_U) instruction. Do not change the two points from the device specified by (d2). If they are changed, an error may occur. (Error code: 3285H)
- If the value in (n) is changed during sorting, the new number of sort data is used for sorting.
- If the execution command is turned off during sorting, sorting is interrupted. If the execution command is turned on again, sorting is performed from the beginning.
- If the next sorting is performed continuously after completion of the previous sorting, the execution command needs to be turned off and turned on again.

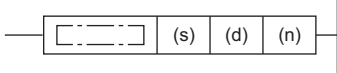
## Operation error

| Error code (SD0) | Description                                                                                                                                                       |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The device range of $2 \times (n)$ points from the device specified by (s1) and the device range of two points from the device specified by (d2) are overlapping. |
| 3285H            | The value in (s2) is 0.                                                                                                                                           |
|                  | In the second scan or after, the value in (d2) used by the system is equal to or greater than the value in (n).                                                   |
|                  | In the second scan or after, the value in (d2) used by the system is $(d2) < (d2)+1$ .                                                                            |

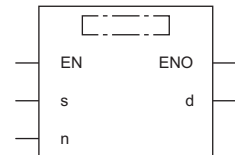
# Adding 16-bit binary data

## WSUM(P)(\_U)

These instructions add the (n) points of 16-bit binary data from the specified device.

| Ladder                                                                            | ST                                            |                                                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------------------|
|  | ENO:=WSUM(EN,s,n,d);<br>ENO:=WSUMP(EN,s,n,d); | ENO:=WSUM_U(EN,s,n,d);<br>ENO:=WSUMP_U(EN,s,n,d); |

## FBD/LD



## ■Execution condition

| Instruction      | Execution condition                                                               |
|------------------|-----------------------------------------------------------------------------------|
| WSUM<br>WSUM_U   |  |
| WSUMP<br>WSUMP_U |  |

## Setting data

## ■Description, range, data type

| Operand | Description         | Range      | Data type              | Data type (label) |
|---------|---------------------|------------|------------------------|-------------------|
| (s)     | WSUM(P)             | —          | 16-bit signed binary   | ANY16_S*1         |
|         | WSUM(P)_U           |            | 16-bit unsigned binary | ANY16_U*1         |
| (d)     | WSUM(P)             | —          | 32-bit signed binary   | ANY32_S           |
|         | WSUM(P)_U           |            | 32-bit unsigned binary | ANY32_U           |
| (n)     | Number of data      | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition | —          | Bit                    | BOOL              |
| ENO     | Execution result    | —          | Bit                    | BOOL              |

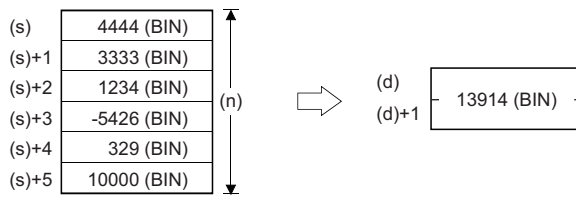
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

These instructions add the (n) points of 16-bit binary data in the device starting from the one specified by (s), and store the result in the device specified by (d).



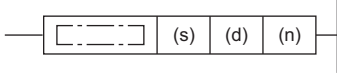
## Operation error

There is no operation error.

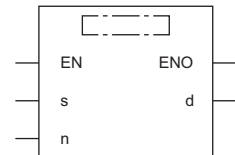
# Adding 32-bit binary data

## DWSUM(P)(\_U)

These instructions add the (n) points of 32-bit binary data in the devices starting from the specified one.

| Ladder                                                                            | ST                                              |                                                     |
|-----------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------|
|  | ENO:=DWSUM(EN,s,n,d);<br>ENO:=DWSUMP(EN,s,n,d); | ENO:=DWSUM_U(EN,s,n,d);<br>ENO:=DWSUMP_U(EN,s,n,d); |

## FBD/LD



## Execution condition

| Instruction        | Execution condition                                                               |
|--------------------|-----------------------------------------------------------------------------------|
| DWSUM<br>DWSUM_U   |  |
| DWSUMP<br>DWSUMP_U |  |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description         | Range      | Data type              | Data type (label)       |
|---------|---------------------|------------|------------------------|-------------------------|
| (s)     | DWSUM(P)            | —          | 32-bit signed binary   | ANY32_S <sup>*1</sup>   |
|         | DWSUM(P)_U          |            | 32-bit unsigned binary | ANY32_U <sup>*1</sup>   |
| (d)     | DWSUM(P)            | —          | 64-bit signed binary   | ANY32_ARRAY             |
|         | DWSUM(P)_U          |            | 64-bit unsigned binary | (Number of elements: 2) |
| (n)     | Number of data      | 0 to 65535 | 16-bit unsigned binary | ANY16                   |
| EN      | Execution condition | —          | Bit                    | BOOL                    |
| ENO     | Execution result    | —          | Bit                    | BOOL                    |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

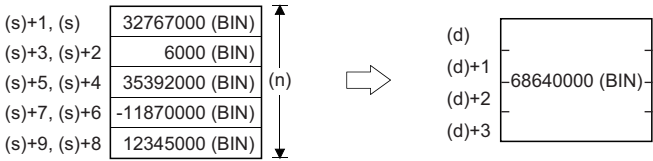
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |



### Processing details

These instructions add the (n) points of 32-bit binary data in the device starting from the one specified by (s), and store the result in the device specified by (d).



### Operation error

There is no operation error.

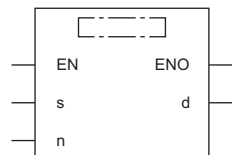
# Calculating the mean value of 16-bit binary data

## MEAN(P)(\_U)

These instructions calculate the average value of the (n) points of 16-bit data in the devices starting from the specified one.

| Ladder | ST                                            |                                                   |
|--------|-----------------------------------------------|---------------------------------------------------|
|        | ENO:=MEAN(EN,s,n,d);<br>ENO:=MEANP(EN,s,n,d); | ENO:=MEAN_U(EN,s,n,d);<br>ENO:=MEANP_U(EN,s,n,d); |

## FBD/LD



## Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| MEAN<br>MEAN_U   |                     |
| MEANP<br>MEANP_U |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand   | Description                                                              | Range      | Data type              | Data type (label)     |
|-----------|--------------------------------------------------------------------------|------------|------------------------|-----------------------|
| (s)       | Start device where the data for calculating the average value are stored | —          | 16-bit signed binary   | ANY16_S <sup>*1</sup> |
| MEAN(P)_U |                                                                          |            | 16-bit unsigned binary | ANY16_U <sup>*1</sup> |
| (d)       | Device for storing the mean value                                        | —          | 16-bit signed binary   | ANY16_S               |
| MEAN(P)_U |                                                                          |            | 16-bit unsigned binary | ANY16_U               |
| (n)       | Number of data, or the device number where the number of data is stored  | 0 to 65535 | 16-bit unsigned binary | ANY16                 |
| EN        | Execution condition                                                      | —          | Bit                    | BOOL                  |
| ENO       | Execution result                                                         | —          | Bit                    | BOOL                  |

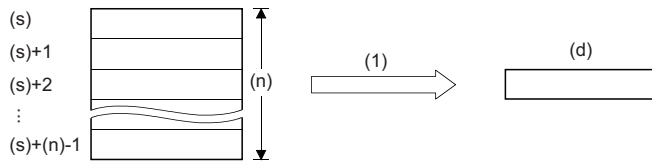
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions calculate the average value of the (n) points of 16-bit binary data in the devices starting from the one specified by (s), and stores the average value in the device specified by (d).



(1) Mean value

- If the calculation result is not an integer, the first decimal place is rounded down.
- When (n) is 0, the processing is not performed.

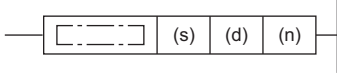
## Operation error

There is no operation error.

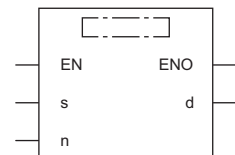
# Calculating the mean value of 32-bit binary data

## DMEAN(P)(\_U)

These instructions calculate the average value of the (n) points of 32-bit data in the devices starting from the specified one.

| Ladder                                                                            | ST                                              |                                                     |
|-----------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------|
|  | ENO:=DMEAN(EN,s,n,d);<br>ENO:=DMEANP(EN,s,n,d); | ENO:=DMEAN_U(EN,s,n,d);<br>ENO:=DMEANP_U(EN,s,n,d); |

## FBD/LD



## ■Execution condition

| Instruction        | Execution condition                                                               |
|--------------------|-----------------------------------------------------------------------------------|
| DMEAN<br>DMEAN_U   |  |
| DMEANP<br>DMEANP_U |  |

## Setting data

## ■Descriptions, ranges, and data types

| Operand | Description                                                              | Range      | Data type              | Data type (label)     |
|---------|--------------------------------------------------------------------------|------------|------------------------|-----------------------|
| (s)     | Start device where the data for calculating the average value are stored | —          | 32-bit signed binary   | ANY32_S <sup>*1</sup> |
|         |                                                                          |            | 32-bit unsigned binary | ANY32_U <sup>*1</sup> |
| (d)     | Start device for storing the average value                               | —          | 32-bit signed binary   | ANY32_S               |
|         |                                                                          |            | 32-bit unsigned binary | ANY32_U               |
| (n)     | Number of data, or the device number where the number of data is stored  | 0 to 65535 | 16-bit unsigned binary | ANY16                 |
| EN      | Execution condition                                                      | —          | Bit                    | BOOL                  |
| ENO     | Execution result                                                         | —          | Bit                    | BOOL                  |

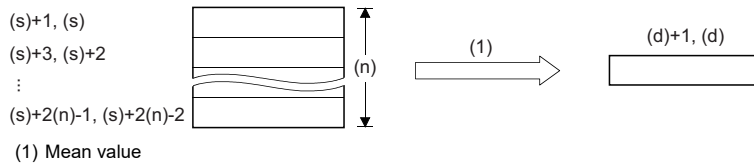
\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions calculate the average value of the (n) points of 32-bit binary data in the devices starting from the one specified by (s), and stores the average value in the device specified by (d).



- If the calculation result is not an integer, the first decimal place is rounded down.
- When (n) is 0, the processing is not performed.

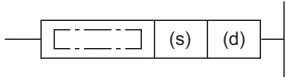
## Operation error

There is no operation error.

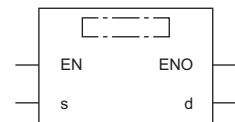
# Calculating the square root of 16-bit binary data

## SQRT(P)

These instructions perform a square root operation of the specified 16-bit binary data.

| Ladder                                                                            | ST <sup>*1</sup>    |
|-----------------------------------------------------------------------------------|---------------------|
|  | ENO:=SQRTP(EN,s,d); |

## FBD/LD<sup>\*1</sup>



<sup>\*1</sup> The SQRT instruction is not supported by the structured text language and the FBD/LD language. Use the standard function, SQRT.  
( Page 1318 SQRT(\_E))

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| SQRT        |  |
| SQRTP       |  |

## Setting data

## Description, range, data type

| Operand | Description                                                           | Range      | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------|------------|------------------------|-------------------|
| (s)     | Device where the data whose square root is to be calculated is stored | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| (d)     | Device where the obtained square root is stored                       | —          | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition                                                   | —          | Bit                    | BOOL              |
| ENO     | Execution result                                                      | —          | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |              |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|--------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○ <sup>*1</sup>                  | ○    | ○                                     | ○            | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○ <sup>*1</sup>                  | ○    | ○                                     | ○            | ○ | —           | —  | ○                      | —        | — | —  | —      |

<sup>\*1</sup> FX and FY cannot be used.

## Processing details

These instructions perform a square root operation of the 16-bit binary data specified by (s). and stores the result in (d). The obtained square root is an integer because the decimal places are rounded down.

$$\sqrt{(s)} \rightarrow (d)$$

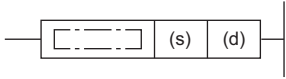
## Operation error

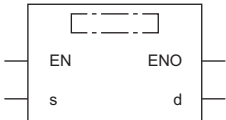
There is no operation error.

# Calculating the square root of 32-bit binary data

## DSQRT(P)

These instructions perform a square root operation of the specified 32-bit binary data.

| Ladder                                                                            | ST                                          |
|-----------------------------------------------------------------------------------|---------------------------------------------|
|  | ENO:=DSQRT(EN,s,d);<br>ENO:=DSQRTP(EN,s,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DSQRT       |  |
| DSQRTP      |  |

## Setting data

## Description, range, data type

| Operand | Description                                                           | Range           | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Device where the data whose square root is to be calculated is stored | 0 to 4294967295 | 32-bit unsigned binary | ANY32             |
| (d)     | Device where the obtained square root is stored                       | —               | 32-bit unsigned binary | ANY32             |
| EN      | Execution condition                                                   | —               | Bit                    | BOOL              |
| ENO     | Execution result                                                      | —               | Bit                    | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○*1                              | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○*1                              | ○   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

\*1 FX and FY cannot be used.

## Processing details

These instructions perform a square root operation of the 32-bit binary data specified by (s). and stores the result in (d). The obtained square root is an integer because the decimal places are rounded down.

$$\sqrt{(s)+1}, (\overline{s}) \rightarrow (d)$$

## Operation error

There is no operation error.

# CRC operation

## CRC(P)

These instructions generate the CRC value for (n) 8-bit data (unit: byte) starting from the device specified by (s), and store the CRC value to the device specified by (d).

| Ladder | ST                                          |
|--------|---------------------------------------------|
|        | ENO:=CRC(EN,s,n,d);<br>ENO:=CRCP(EN,s,n,d); |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| CRC         |                     |
| CRCP        |                     |

## Setting data

### Description, range, data type

| Operand | Description                                                                                                                        | Range      | Data type              | Data type (label) |
|---------|------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------|-------------------|
| (s)     | Start device where the target data of CRC value generation is stored                                                               | —          | 16-bit signed binary   | ANY16             |
| (d)     | Device where the generated CRC value is stored                                                                                     | —          | 16-bit signed binary   | ANY16             |
| (n)     | Number of 8-bit data (unit: byte) for which the CRC value is generated or the device storing the number of 8-bit data (unit: byte) | 0 to 65535 | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition                                                                                                                | —          | Bit                    | BOOL              |
| ENO     | Execution result                                                                                                                   | —          | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○*1                              | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○*1                              | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○*1                              | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | —      |

\*1 FX and FY cannot be used.



## Processing details

- These instructions generate the CRC value for (n) 8-bit data (unit: byte) starting from the device specified by (s), and store the CRC value to the device specified by (d). " $X^{16} + X^{15} + X^2 + 1$ " is used in the generator polynomial of the CRC value (CRC-16). The 16-bit conversion mode and 8-bit conversion mode are available for these instructions. The conversion mode can be selected by turning on or off SM772.
- If the value specified by (n) is 0, no processing is performed.
- The operation in each conversion mode is described below.

### ■16-bit conversion mode (while SM772 is OFF)

In this mode, the CRC operation is executed for upper 8 bits (in units of byte) and lower 8 bits (in units of byte) of the device specified by (s). The operation result is stored to 16 bits in one device specified by (d).

#### Ex.

When (n)=6

In 16-bit conversion mode, the six bytes in the following shaded portion become an operation target. The CRC value is determined as "A57BH", and therefore "A57BH" is stored in the device specified by (d).

|    | Decimal | Hexadecimal |       |
|----|---------|-------------|-------|
|    |         | Upper       | Lower |
| D0 | 24932   | 61H         | 64H   |
| D1 | 4219    | 10H         | 7BH   |
| D2 | -1333   | FAH         | CBH   |
| D3 | -1      | FFH         | FFH   |
| D4 | 32761   | 7FH         | F9H   |
| D5 | 10000   | 27H         | 10H   |

### ■8-bit conversion mode (while SM772 is ON)

CRC operation is executed only for lower 8 bits (lower byte) of the device specified by (s). With regard to the operation result, lower 8 bits (in units of byte) are stored to the device specified by (d), and upper 8 bits (in units of byte) are stored to a device specified by (d)+1.

#### Ex.

When (n)=6

In 8-bit conversion mode, the six bytes in the following shaded portion become an operation target. The CRC value is "BDA1H" and therefore "A1H" is stored in the device specified by (d) and "BDH" is stored in the device specified by (d)+1.

|    | Decimal | Hexadecimal |       |
|----|---------|-------------|-------|
|    |         | Upper       | Lower |
| D0 | 24932   | 61H         | 64H   |
| D1 | 4219    | 10H         | 7BH   |
| D2 | -1333   | FAH         | CBH   |
| D3 | -1      | FFH         | FFH   |
| D4 | 32761   | 7FH         | F9H   |
| D5 | 10000   | 27H         | 10H   |

## Operation error

| Error code (SD0) | Description                                                                         |
|------------------|-------------------------------------------------------------------------------------|
| 3285H            | A digit other than 4 is specified in the digit-specified bit device in (s) and (d). |

# 15 DEBUGGING AND FAILURE DIAGNOSTIC

## 15.1 Debugging and Failure Diagnostic Instructions

### Resetting the error display and the annunciator display

#### LEDR

This instruction resets the self-diagnostic error (continuation error) display and the annunciator display of the controller.

| Ladder | ST             |
|--------|----------------|
|        | ENO:=LEDR(EN); |

| FBD/LD |
|--------|
|        |

#### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| LEDR        |                     |

#### Processing details

- This instruction resets the self-diagnostic error (continuation error) display and the annunciator display of the controller.  
Executing the instruction once resets both the error display and the annunciator display.
- When a self-diagnostic error has occurred, the controller operates as follows:
  - When a self-diagnostic error (continuation error) has occurred  
The ERROR LED on the front of the controller remains off.  
The values in SM0, SM1, and SD0 are not reset automatically at this time. Reset the values by the program.
  - When a battery error has occurred  
When the LEDR instruction is executed after battery replacement, the BATTERY LED on the front of the controller turns off. At this time, SM51 also turns off.
- When the annunciator (F) is on, the controller operates as follows:
  - The USER LED turns off.
  - The values in SD62, SD63, and SD64 to SD79 are all cleared to 0.

| Before execution | After execution |
|------------------|-----------------|
| SD62 200         | SD62 0          |
| SD63 15          | SD63 0          |
| SD64 200         | SD64 0          |
| SD65 99          | SD65 0          |
| SD66 5           | SD66 0          |
| SD67 255         | SD67 0          |
| ⋮                | ⋮               |
| SD78 83          | SD78 0          |
| SD79 0           | SD79 0          |

(1)

(1) All data are cleared.

#### Operation error

There is no operation error.



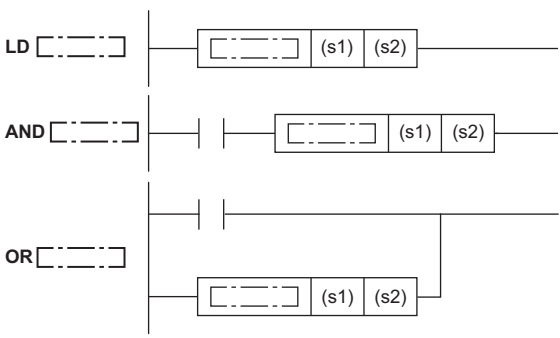
# 16 STRING PROCESSING

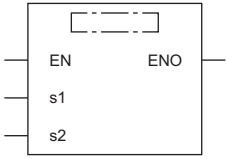
## 16.1 String Processing Instructions

### Comparing string data

#### LD\$, AND\$, OR\$

These instructions compare string data as normally open contacts.

| Ladder                                                                            | ST                                                                                                                                                            |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | ENO:=LDSTRING_□(EN,s1,s2);<br>ENO:=ANDSTRING_□(EN,s1,s2);<br>ENO:=ORSTRING_□(EN,s1,s2);<br>(□ is replaced by any of the following: EQ, NE, GT, LE, LT, GE.)*1 |
| (□ is replaced by \$=, \$<>, \$>, \$<=, \$<, or \$>=.)                            |                                                                                                                                                               |

| FBD/LD                                                                                                   |
|----------------------------------------------------------------------------------------------------------|
|                       |
| (□ is replaced by a combination of LDSTRING_, ANDSTRING_, or ORSTRING_ and EQ, NE, GT, LE, LT, or GE.)*1 |

\*1 EQ indicates =, NE indicates <>, GT indicates >, LE indicates <=, LT indicates <, and GE indicates >=.

#### ■Execution condition

| Instruction       | Execution condition |
|-------------------|---------------------|
| LD\$, AND\$, OR\$ | Every scan          |

### Setting data

#### ■Description, range, data type

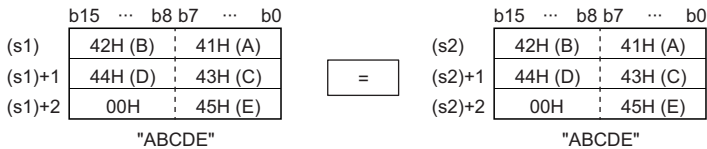
| Operand | Description                                                             | Range | Data type | Data type (label) |
|---------|-------------------------------------------------------------------------|-------|-----------|-------------------|
| (s1)    | Comparison data or the start device where the comparison data is stored | —     | String    | ANYSTRING_SINGLE  |
| (s2)    | Comparison data or the start device where the comparison data is stored | —     | String    | ANYSTRING_SINGLE  |
| EN      | Execution condition                                                     | —     | Bit       | BOOL              |
| ENO     | Execution result                                                        | —     | Bit       | BOOL              |

#### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |

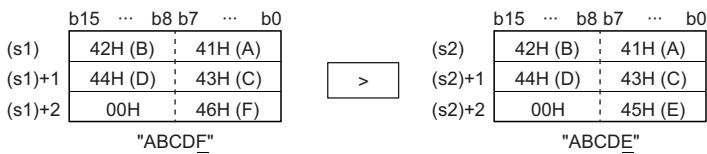
## Processing details

- These instructions perform a comparison operation between the string data in the device specified by (s1) and the string data in the device specified by (s2). (Devices are used as normally open contacts).
- In comparison operation, the ASCII code of string is compared character by character from the beginning of the string.
- The strings in the devices specified by (s1) and (s2) mean those in the device numbers from the specified one to the one containing 00H.
- The comparison result turns out matching if all strings match.



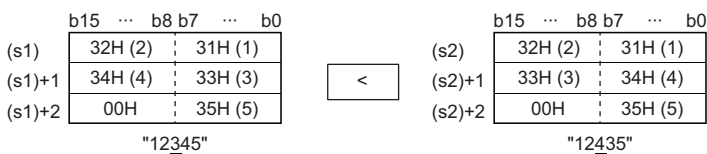
| □ Instruction symbol (ladder, FBD/LD) | Result                             |
|---------------------------------------|------------------------------------|
| \$=, EQ                               | Continuity state (ENO is on.)      |
| \$<>, NE                              | Non-continuity state (ENO is off.) |
| \$>, GT                               | Non-continuity state (ENO is off.) |
| \$<=, LE                              | Continuity state (ENO is on.)      |
| \$<, LT                               | Non-continuity state (ENO is off.) |
| \$>=, GE                              | Continuity state (ENO is on.)      |

- When different strings are compared, the string with a larger character code is greater.



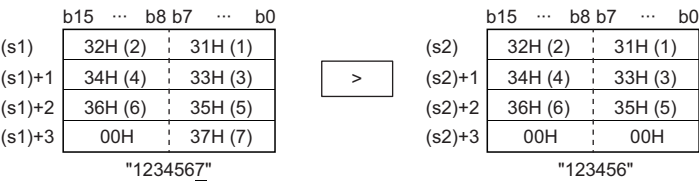
| □ Instruction symbol (ladder, FBD/LD) | Result                             |
|---------------------------------------|------------------------------------|
| \$=, EQ                               | Non-continuity state (ENO is off.) |
| \$<>, NE                              | Continuity state (ENO is on.)      |
| \$>, GT                               | Continuity state (ENO is on.)      |
| \$<=, LE                              | Non-continuity state (ENO is off.) |
| \$<, LT                               | Non-continuity state (ENO is off.) |
| \$>=, GE                              | Continuity state (ENO is on.)      |

- When different strings are compared, the relative size of a string is determined by the relative size of the first different character codes.



| □ Instruction symbol (ladder, FBD/LD) | Result                             |
|---------------------------------------|------------------------------------|
| \$=, EQ                               | Non-continuity state (ENO is off.) |
| \$<>, NE                              | Continuity state (ENO is on.)      |
| \$>, GT                               | Non-continuity state (ENO is off.) |
| \$<=, LE                              | Continuity state (ENO is on.)      |
| \$<, LT                               | Continuity state (ENO is on.)      |
| \$>=, GE                              | Non-continuity state (ENO is off.) |

- When the lengths of the string data in the devices specified by (s1) and (s2) are different, the longer string data is greater.



| □ Instruction symbol (ladder, FBD/LD) | Result                             |
|---------------------------------------|------------------------------------|
| \$=, EQ                               | Non-continuity state (ENO is off.) |
| \$<>, NE                              | Continuity state (ENO is on.)      |
| \$>, GT                               | Continuity state (ENO is on.)      |
| \$<=, LE                              | Non-continuity state (ENO is off.) |
| \$<, LT                               | Non-continuity state (ENO is off.) |
| \$>=, GE                              | Continuity state (ENO is on.)      |

- The string in the device specified by (s1) or (s2) exceeds 16383 characters, the operation result will be non-continuity (ENO OFF).
- If the LDSTRING\_□ instruction is used in the program written in FBD/LD, use a left rail or a variable/constant which is always on for EN.
- If the ORSTRING\_□ instruction is used in the program written in FBD/LD and EN is set to TRUE, ENO turns on. EN will not be an execution condition.

### Operation error

There is no operation error.

**Point**

The string comparison instructions perform the following checks while comparing strings.

- Checking whether the device area range is exceeded
- Checking whether the string is within 16383 characters

If 00H does not exist in the device area or the string exceeds 16383 characters and a character mismatch is detected, the instruction outputs comparison operation results without causing non-continuity (ENO OFF). The following example shows the operation result when the last device number of the device area is D12287.

(s1)      (s2)

(s1)

"ABCDEF"

↑ (1)

(s2)

b15...b8
b7...b0

"Z"
"A"

D12287

(2) →

Outside the device area

(1) The second character of (s1) differs from that of (s2) ((s1)≠(s2)), and accordingly the operation result will be continuity (ENO ON).

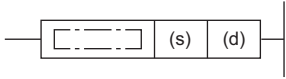
(2) D12287 and later are outside the device area, and accordingly string data comparison is performed using data up to D12287.

Since a string mismatch has been detected, the condition is satisfied and processing ends.

# Concatenating string data

## \$+(P) [when two operands are set]

These instructions concatenate string data.

| Ladder                                                                                                                                              | ST                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                    | Not supported<br>(  Page 727 \$+(P) [when three operands are set]) |
| FBD/LD                                                                                                                                              |                                                                                                                                                     |
| Not supported<br>(  Page 727 \$+(P) [when three operands are set]) |                                                                                                                                                     |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| \$+         |  |
| \$+P        |  |

## Setting data

## Description, range, data type

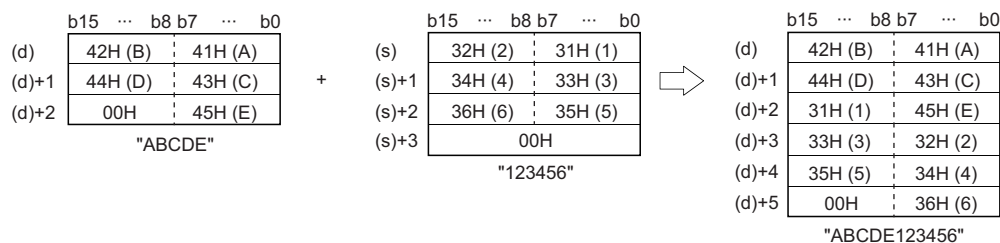
| Operand | Description                                                     | Range | Data type | Data type (label) |
|---------|-----------------------------------------------------------------|-------|-----------|-------------------|
| (s)     | Data to be concatenated or the start device containing the data | —     | String    | ANYSTRING_SINGLE  |
| (d)     | Start device where the data to be concatenated is stored        | —     | String    | ANYSTRING_SINGLE  |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- This instruction connects the string stored in the device number specified by (s) and later to the end of the string data stored in the device number specified by (d) and later, and stores the connected data in the device number specified by (d) and later.



- For concatenating strings, the instruction ignores 00H that indicates the end of the string in the device specified by (d) and appends the string in the device specified by (s) following the last character in the device specified by (d).

## Operation error

| Error code (SD0) | Description                                                                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the assignment range of the relevant device/label for the device number specified by (s) and later.                                     |
|                  | There is no NULL code (00H) in the assignment range of the relevant device/label for the device number specified by (d) and later.                                     |
| 2821H            | The device numbers for storing the strings in the devices specified by (s) and (d) are overlapping.                                                                    |
| 3285H            | The number of characters in the string specified by (s) exceeds 16383.                                                                                                 |
|                  | The number of characters in the string specified by (d) exceeds 16383.                                                                                                 |
| 3286H            | The number of characters in the concatenated string ((s)+(d)) exceeds 16383.                                                                                           |
|                  | The entire string after concatenate processing in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored. |



## \$+(P) [when three operands are set]

These instructions concatenate string data.

| Ladder                                        | ST                                                                    |
|-----------------------------------------------|-----------------------------------------------------------------------|
|                                               | <pre>ENO:=STRINGPLUS(EN,s1,s2,d); ENO:=STRINGPLUSP(EN,s1,s2,d);</pre> |
| FBD/LD                                        |                                                                       |
|                                               |                                                                       |
| (□ is replaced by STRINGPLUS or STRINGPLUSP.) |                                                                       |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| \$+         |                     |
| \$+P        |                     |

### Setting data

### Descriptions, ranges, and data types

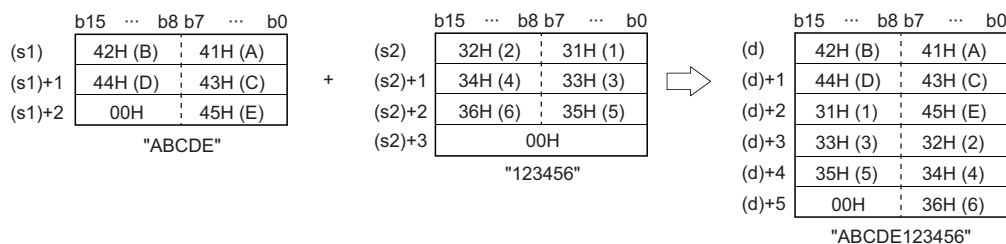
| Operand | Description                                                                        | Range | Data type | Data type (label) |
|---------|------------------------------------------------------------------------------------|-------|-----------|-------------------|
| (s1)    | Data to be concatenated or the start device containing the data                    | —     | String    | ANYSTRING_SINGLE  |
| (s2)    | Data to be concatenated or the start device containing the data to be concatenated | —     | String    | ANYSTRING_SINGLE  |
| (d)     | Start device for storing the concatenated data                                     | —     | String    | ANYSTRING_SINGLE  |
| EN      | Execution condition                                                                | —     | Bit       | BOOL              |
| ENO     | Execution result                                                                   | —     | Bit       | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           | Z | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | ○  | —      |
| (s2)    | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- This instruction connects the string stored in the device number specified by (s2) and later to the end of the string data stored in the device number specified by (s1) and later, and stores the connected data in the device number specified by (d) and later.



- For concatenating strings, the instruction ignores 00H that indicates the end of the string in the device specified by (s1) and appends the string in the device specified by (s2) following the last character in the device specified by (s1).

## Operation error

| Error code (SD0) | Description                                                                                                                                                       |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the assignment range of the relevant device/label for the device number specified by (s1) and later.                               |
|                  | There is no NULL code (00H) in the assignment range of the relevant device/label for the device number specified by (s2) and later.                               |
| 2821H            | The device numbers for storing the strings in the devices specified by (s2) and (d) are overlapping.                                                              |
| 3285H            | The number of characters in the string specified by (s1) exceeds 16383.                                                                                           |
|                  | The number of characters in the string specified by (s2) exceeds 16383.                                                                                           |
| 3286H            | The string stored in the device specified by (d) is out of the output enable range.                                                                               |
|                  | • The number of characters in the concatenated string exceeds 16383.                                                                                              |
|                  | • The entire string after concatenate processing in the assignment range of the relevant device/label for the specified device number and later cannot be stored. |

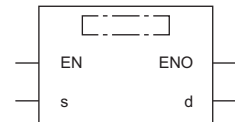
## Transferring string data

### \$MOV(P)

These instructions transfer string data to the specified device number and later.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | ENO:=STRINGMOV(EN,s,d);<br>ENO:=STRINGMOVP(EN,s,d); |

### FBD/LD



(□ is replaced by STRINGMOV or STRINGMOVP.)

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| \$MOV       |                     |
| \$MOVP      |                     |

### Setting data

### ■Descriptions, ranges, and data types

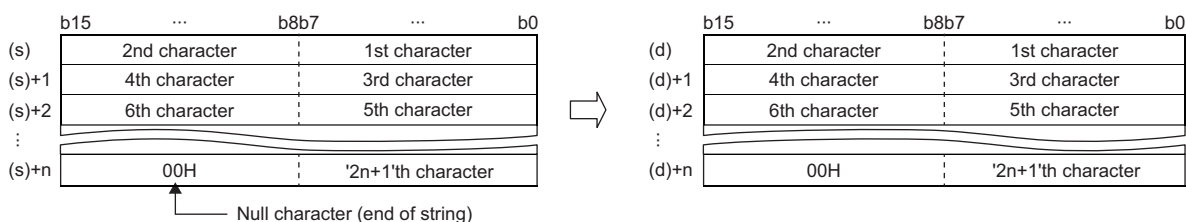
| Operand | Description                                                                                               | Range | Data type | Data type (label) |
|---------|-----------------------------------------------------------------------------------------------------------|-------|-----------|-------------------|
| (s)     | Character string to be transferred (maximum of 255 characters) or the start device containing such string | —     | String    | ANYSTRING_SINGLE  |
| (d)     | Start device for storing the transferred string                                                           | —     | String    | ANYSTRING_SINGLE  |
| EN      | Execution condition                                                                                       | —     | Bit       | BOOL              |
| ENO     | Execution result                                                                                          | —     | Bit       | BOOL              |

### ■Applicable devices

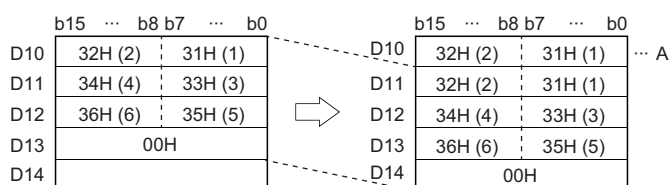
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions transfer the string data in the device specified by (s) to the device number specified by (d) and later. The strings specified by (s) or the strings from the device number specified by (s) to the device number containing 00H are transferred all at once.

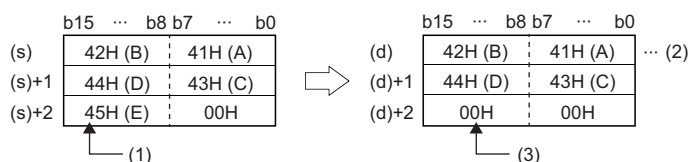


- Even when the device range ((s) to (s)+n) in which the string data to be transferred and the device range ((d) to (d)+n) for storing the transferred data are overlapping, the processing is performed normally. For example, the strings stored in the devices specified by D10 to D13 are transferred to the devices specified by D11 to D14 as shown below.



A: Data remain the same.

- When 00H is stored in the lower byte of (s)+n, 00H will be stored in both upper and lower bytes of (d)+n.



(1) Data (upper byte) is not transferred.

(2) Data remain the same.

(3) 00H is automatically stored in the upper byte.

## Operation error

| Error code (SD0) | Description                                                                                                                                                  |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the assignment range of the relevant device/label for the device number specified by (s) and later.                           |
| 3285H            | The number of characters in the string specified by (s) exceeds 16383.                                                                                       |
| 3286H            | The entire string that was specified in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored. |

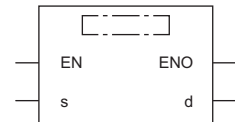
## Transferring Unicode string data

### \$MOV(P)\_WS

These instructions transfer Unicode string data to the specified device number and later.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | ENO:=STRINGMOV_WS(EN,s,d);<br>ENO:=STRINGMOVP_WS(EN,s,d); |

### FBD/LD



(□ is replaced by STRINGMOV\_WS or STRINGMOVP\_WS.)

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| \$MOV_WS    |                     |
| \$MOVP_WS   |                     |

### Setting data

### ■Descriptions, ranges, and data types

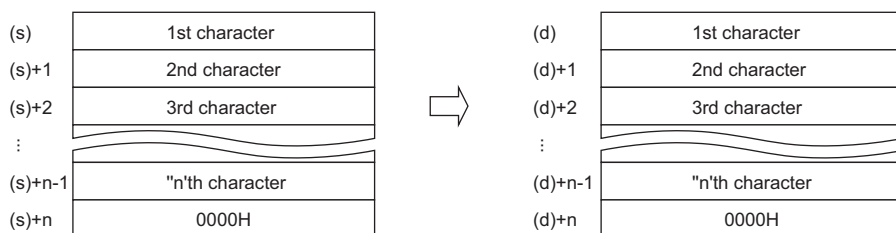
| Operand | Description                                                                                                    | Range | Data type      | Data type (label) |
|---------|----------------------------------------------------------------------------------------------------------------|-------|----------------|-------------------|
| (s)     | Unicode string to be transferred (maximum of 255 characters) or the start device containing the Unicode string | —     | Unicode string | ANYSTRING_DOUBLE  |
| (d)     | Start device for storing the transferred Unicode string                                                        | —     | Unicode string | ANYSTRING_DOUBLE  |
| EN      | Execution condition                                                                                            | —     | Bit            | BOOL              |
| ENO     | Execution result                                                                                               | —     | Bit            | BOOL              |

### ■Applicable devices

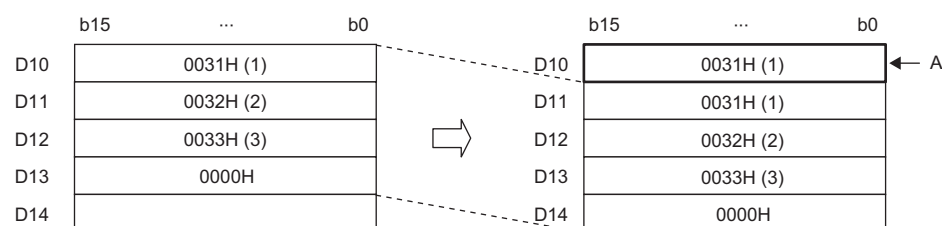
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions transfer the Unicode string data in the device specified by (s) to the device number specified by (d) and later. The Unicode strings specified by (s) or the Unicode strings from the device number specified by (s) to the device number containing 0000H are transferred all at once.



- Even when the device range ((s) to (s)+n) in which the Unicode string data to be transferred and the device range ((d) to (d)+n) for storing the transferred data are overlapping, the processing is performed normally. For example, the strings stored in the devices specified by D10 to D13 are transferred to the devices specified by D11 to D14 as shown below.



A: Same as before transfer

## Operation error

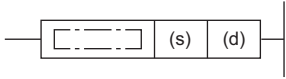
| Error code (SD0) | Description                                                                                                                                                          |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (0000H) in the assignment range of the relevant device/label for the device number specified by (s) and later.                                 |
| 3285H            | The number of characters in the Unicode string specified by (s) exceeds 16383.                                                                                       |
| 3286H            | The entire Unicode string that was specified in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored. |

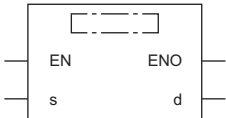
# Converting 16-bit binary data to decimal ASCII

16

## BINDA(P)(\_U)

These instructions convert 16-bit binary data to the decimal ASCII code.

| Ladder                                                                            | ST                                         |                                                |
|-----------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------|
|  | ENO:=BINDA(EN,s,d);<br>ENO:=BINDAP(EN,s,d) | ENO:=BINDA_U(EN,s,d);<br>ENO:=BINDAP_U(EN,s,d) |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction        | Execution condition                                                               |
|--------------------|-----------------------------------------------------------------------------------|
| BINDA<br>BINDA_U   |  |
| BINDAP<br>BINDAP_U |  |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                    | Range           | Data type              | Data type (label) |
|---------|------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | BINDA(P)                                       | -32768 to 32767 | 16-bit signed binary   | ANY16_S           |
|         | BINDA(P)_U                                     | 0 to 65535      | 16-bit unsigned binary | ANY16_U           |
| (d)     | Start device for storing the conversion result | —               | String                 | ANYSTRING_SINGLE  |
| EN      | Execution condition                            | —               | Bit                    | BOOL              |
| ENO     | Execution result                               | —               | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | — | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | — | —      |

## Processing details

- These instructions convert the digit in decimal notation of the 16-bit binary data in the device specified by (s) to the ASCII code, and store the converted data in the device number specified by (d) and later.
- The format of the decimal ASCII data to be stored in (d) depends on the status of SM705 (Number of conversion digits selection).

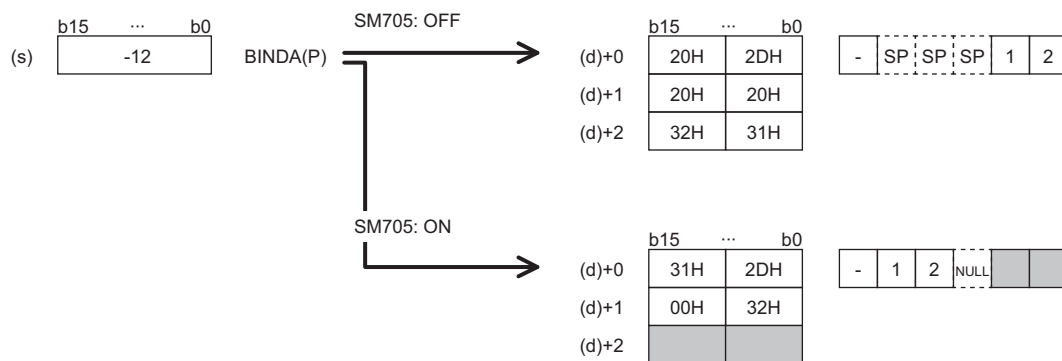
| Status of SM705 | Storage format of (d)                                              | Reference                                                                       |
|-----------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Off             | Data is stored in a fixed number of digits (a sign + 5 digits)     | Page 735 Operation of when SM705 (Number of conversion digits selection) is off |
| On              | Each digit is stored left-justified depending on the value of (s). | Page 735 Operation of when SM705 (Number of conversion digits selection) is on  |

### ■ Operation overview

The following figure shows the operation when SM705 (Number of conversion digits selection) is off and on.

**Ex.**

When the BINDA(P) instruction is executed with the numeric value "-12" stored in (s)

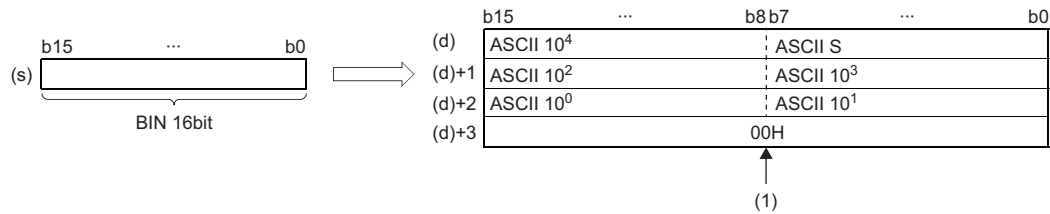


- When SM705 is off, the number of digits is fixed. The first character is a sign and it is 2DH(-) in the above example. (If (s) is 0 or positive, the first character is 20H (space).) The numeric part is right-justified. When the length of the numeric part is less than 5 digits, the ASCII code 20H (space) is stored for the ASCII code of the upper digit(s).
- When SM705 is on, data is left-justified. When the length of the numeric part is less than 5 digits, 00H is stored in the end.



## ■Operation of when SM705 (Number of conversion digits selection) is off

Decimal ASCII data is stored in a fixed number of digits in (d) to (d)+2.



ASCII S: Sign data of ASCII code<sup>\*1</sup>

ASCII 10<sup>4</sup>: Ten-thousands place of ASCII code<sup>\*2</sup>

ASCII 10<sup>3</sup>: Thousands place of ASCII code<sup>\*3</sup>

ASCII 10<sup>2</sup>: Hundreds place of ASCII code<sup>\*4</sup>

ASCII 10<sup>1</sup>: Tens place of ASCII code<sup>\*5</sup>

ASCII 10<sup>0</sup>: Ones place of ASCII code

(1) 00H is stored in (d)+3 when SM701 (Number of output characters selection) is off. When it is on, the value remains unchanged.

\*1 When the value is 0 or positive, 20H (space) is stored. When the value is negative, 2DH (-) is stored.

\*2 When the length of the numeric part is 4 digits or less, 20H (space) is stored in ASCII 10<sup>4</sup>.

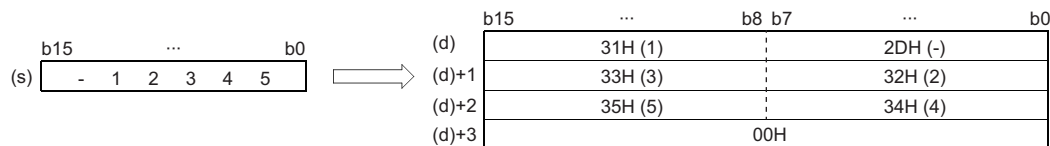
\*3 When the length of the numeric part is 3 digits or less, 20H (space) is stored in ASCII 10<sup>3</sup>.

\*4 When the length of the numeric part is 2 digits or less, 20H (space) is stored in ASCII 10<sup>2</sup>.

\*5 When the length of the numeric part is 1 digit, 20H (space) is stored in ASCII 10<sup>1</sup>.

### Ex.

-12345 is set in (s) when the BINDA(P) instruction is used.



## ■Operation of when SM705 (Number of conversion digits selection) is on

Decimal ASCII data is stored right-justified in (d).

The following figures show an example of a value of (s) and a value stored in (d).

| Value of (s)                                                                                                                                    | Data of (d) to (d)+2                                                                                                                                                                                                                                                                                                                                                                                                                                                | Value of (s) | Data of (d) to (d)+2            |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------------------|-----|-------|-----|----|-----|-----------------------|--|---------------------------------|--|--|-------|-----------------------|--|-----------------------|--|--|-------|-----|--|-----------------------|--|--|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----|-----|-------|-----|----|-----|-----------------------|--|---------------------------------|--|--|-------|-----------------------|--|-----------------------|--|--|-------|-----------------------|--|-----------------------|--|--|-------|-----|--|--|--|--|
| <ul style="list-style-type: none"><li>• 0</li><li>• Positive value (1 digit in numeric part)</li></ul>                                          | <ul style="list-style-type: none"><li>• The upper byte of (d) is filled with 00H.</li><li>• Data in (d)+1 and (d)+2 remains unchanged.</li></ul> <table><tr><td></td><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td colspan="2">00H</td><td colspan="3">ASCII 10<sup>0</sup></td></tr><tr><td>(d)+1</td><td colspan="5"></td></tr><tr><td>(d)+2</td><td colspan="5"></td></tr></table>                                       |              | b15                             | ... | b8 b7 | ... | b0 | (d) | 00H                   |  | ASCII 10 <sup>0</sup>           |  |  | (d)+1 |                       |  |                       |  |  | (d)+2 |     |  |                       |  |  | <ul style="list-style-type: none"><li>• Positive value (2 digits in numeric part)</li><li>• Negative value (1 digit in numeric part)</li></ul> | <ul style="list-style-type: none"><li>• (d)+1 is filled with 00H.</li><li>• Data in (d)+2 remains unchanged.</li></ul> <table><tr><td></td><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td colspan="2">ASCII 10<sup>0</sup></td><td colspan="3">ASCII 10<sup>1</sup> / 2DH (-)</td></tr><tr><td>(d)+1</td><td colspan="5">00H</td></tr><tr><td>(d)+2</td><td colspan="5"></td></tr></table>                                                                                                                                              |  | b15 | ... | b8 b7 | ... | b0 | (d) | ASCII 10 <sup>0</sup> |  | ASCII 10 <sup>1</sup> / 2DH (-) |  |  | (d)+1 | 00H                   |  |                       |  |  | (d)+2 |                       |  |                       |  |  |       |     |  |  |  |  |
|                                                                                                                                                 | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ...          | b8 b7                           | ... | b0    |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)                                                                                                                                             | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              | ASCII 10 <sup>0</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)+1                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)+2                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
|                                                                                                                                                 | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ...          | b8 b7                           | ... | b0    |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)                                                                                                                                             | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                               |              | ASCII 10 <sup>1</sup> / 2DH (-) |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)+1                                                                                                                                           | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)+2                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| ⋮                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| <ul style="list-style-type: none"><li>• Positive value (5 digits in numeric part)</li><li>• Negative value (4 digits in numeric part)</li></ul> | <p>The upper byte of (d)+2 is filled with 00H.</p> <table><tr><td></td><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td colspan="2">ASCII 10<sup>3</sup></td><td colspan="3">ASCII 10<sup>4</sup> / 2DH (-)</td></tr><tr><td>(d)+1</td><td colspan="2">ASCII 10<sup>1</sup></td><td colspan="3">ASCII 10<sup>2</sup></td></tr><tr><td>(d)+2</td><td colspan="2">00H</td><td colspan="3">ASCII 10<sup>0</sup></td></tr></table> |              | b15                             | ... | b8 b7 | ... | b0 | (d) | ASCII 10 <sup>3</sup> |  | ASCII 10 <sup>4</sup> / 2DH (-) |  |  | (d)+1 | ASCII 10 <sup>1</sup> |  | ASCII 10 <sup>2</sup> |  |  | (d)+2 | 00H |  | ASCII 10 <sup>0</sup> |  |  | Negative value (5 digits in numeric part)                                                                                                      | <p>(1) (d)+3 is filled with 00H only when SM701 (Number of output characters selection) is off.</p> <table><tr><td></td><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td colspan="2">ASCII 10<sup>4</sup></td><td colspan="3">2DH (-)</td></tr><tr><td>(d)+1</td><td colspan="2">ASCII 10<sup>2</sup></td><td colspan="3">ASCII 10<sup>3</sup></td></tr><tr><td>(d)+2</td><td colspan="2">ASCII 10<sup>0</sup></td><td colspan="3">ASCII 10<sup>1</sup></td></tr><tr><td>(d)+3</td><td colspan="5">00H</td></tr></table> <p>↑<br/>(1)</p> |  | b15 | ... | b8 b7 | ... | b0 | (d) | ASCII 10 <sup>4</sup> |  | 2DH (-)                         |  |  | (d)+1 | ASCII 10 <sup>2</sup> |  | ASCII 10 <sup>3</sup> |  |  | (d)+2 | ASCII 10 <sup>0</sup> |  | ASCII 10 <sup>1</sup> |  |  | (d)+3 | 00H |  |  |  |  |
|                                                                                                                                                 | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ...          | b8 b7                           | ... | b0    |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)                                                                                                                                             | ASCII 10 <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                               |              | ASCII 10 <sup>4</sup> / 2DH (-) |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)+1                                                                                                                                           | ASCII 10 <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                               |              | ASCII 10 <sup>2</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)+2                                                                                                                                           | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              | ASCII 10 <sup>0</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
|                                                                                                                                                 | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ...          | b8 b7                           | ... | b0    |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)                                                                                                                                             | ASCII 10 <sup>4</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                               |              | 2DH (-)                         |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)+1                                                                                                                                           | ASCII 10 <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                               |              | ASCII 10 <sup>3</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)+2                                                                                                                                           | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                               |              | ASCII 10 <sup>1</sup>           |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |
| (d)+3                                                                                                                                           | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |                                 |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |     |  |                       |  |  |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |     |       |     |    |     |                       |  |                                 |  |  |       |                       |  |                       |  |  |       |                       |  |                       |  |  |       |     |  |  |  |  |

ASCII 10<sup>4</sup>: Ten-thousands place of ASCII code

ASCII 10<sup>3</sup>: Thousands place of ASCII code

ASCII 10<sup>2</sup>: Hundreds place of ASCII code

ASCII 10<sup>1</sup>: Tens place of ASCII code

ASCII 10<sup>0</sup>: Ones place of ASCII code

- When the number of operation digits is less than the maximum number of digits (sign + 5 digits), 00H is stored in the end of the string regardless of the status (on/off) of SM701 (Number of output characters selection). If the end of the string is the lower byte, 00H is also stored in the upper byte.
- When the number of operation digits is equal to the maximum number of digits (a sign + 5 digits), 00H is stored in (d)+3 when SM701 is off. (d)+3 remains unchanged if SM701 is on.

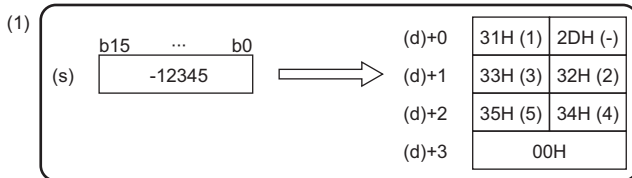
## Operation error

There is no operation error.

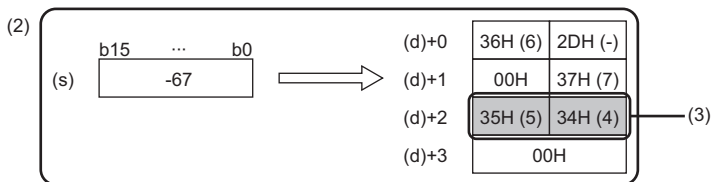
## Precautions

When SM705 (Number of conversion digits selection) is on, the operation result is stored in (d) for the effective number of digits. Therefore, when the BINDA(P)(\_U) instruction is executed successively and the operation result for each execution is stored in the same device, a part of the previous operation result may not be overwritten by the succeeding result and can remain in (d).

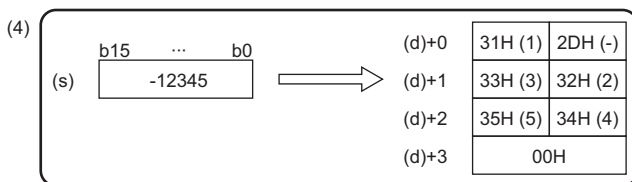
[Example] Executing the BINDA(P) instruction when (s) is "-12345" and then executing another BINDA(P) instruction when (s) is "-67"



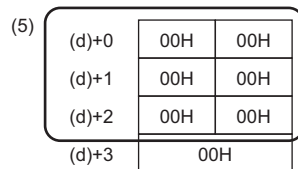
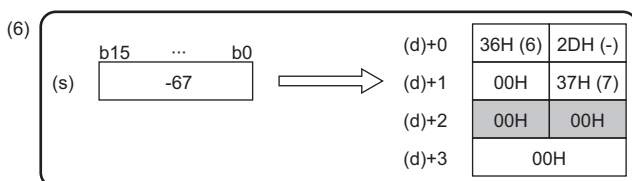
- (1) "-12345" is converted into a string.
- (2) "-67" is converted into a string.
- (3) A part of the previous conversion result remains in (d)+2.



To avoid this, create a program to clear the entire data storage areas (d)+0 to (d)+2 before executing the BINDA(P)(\_U) instruction.



- (4) "-12345" is converted into a string.
- (5) (d)+0 to (d)+2 are cleared.
- (6) "-67" is converted into a string.

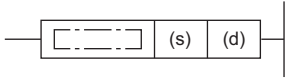


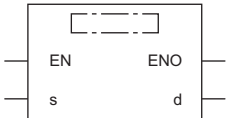
# Converting 32-bit binary data to decimal ASCII

16

## DBINDA(P)(\_U)

These instructions convert 32-bit binary data to the decimal ASCII code.

| Ladder                                                                            | ST                                            |                                                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------------------|
|  | ENO:=DBINDA(EN,s,d);<br>ENO:=DBINDAP(EN,s,d); | ENO:=DBINDA_U(EN,s,d);<br>ENO:=DBINDAP_U(EN,s,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction          | Execution condition                                                               |
|----------------------|-----------------------------------------------------------------------------------|
| DBINDA<br>DBINDA_U   |  |
| DBINDAP<br>DBINDAP_U |  |

### Setting data

### Descriptions, ranges, and data types

| Operand |             | Description                                    | Range                     | Data type              | Data type (label) |
|---------|-------------|------------------------------------------------|---------------------------|------------------------|-------------------|
| (s)     | DBINDA(P)   | Binary data used for ASCII conversion          | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S           |
|         | DBINDA(P)_U |                                                | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U           |
| (d)     |             | Start device for storing the conversion result | —                         | String                 | ANYSTRING_SINGLE  |
| EN      |             | Execution condition                            | —                         | Bit                    | BOOL              |
| ENO     |             | Execution result                               | —                         | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the digit in decimal notation of the 32-bit binary data in the device specified by (s) to the ASCII code, and store the converted data in the device number specified by (d) and later.
- The format of the decimal ASCII data to be stored in (d) depends on the status of SM705 (Number of conversion digits selection).

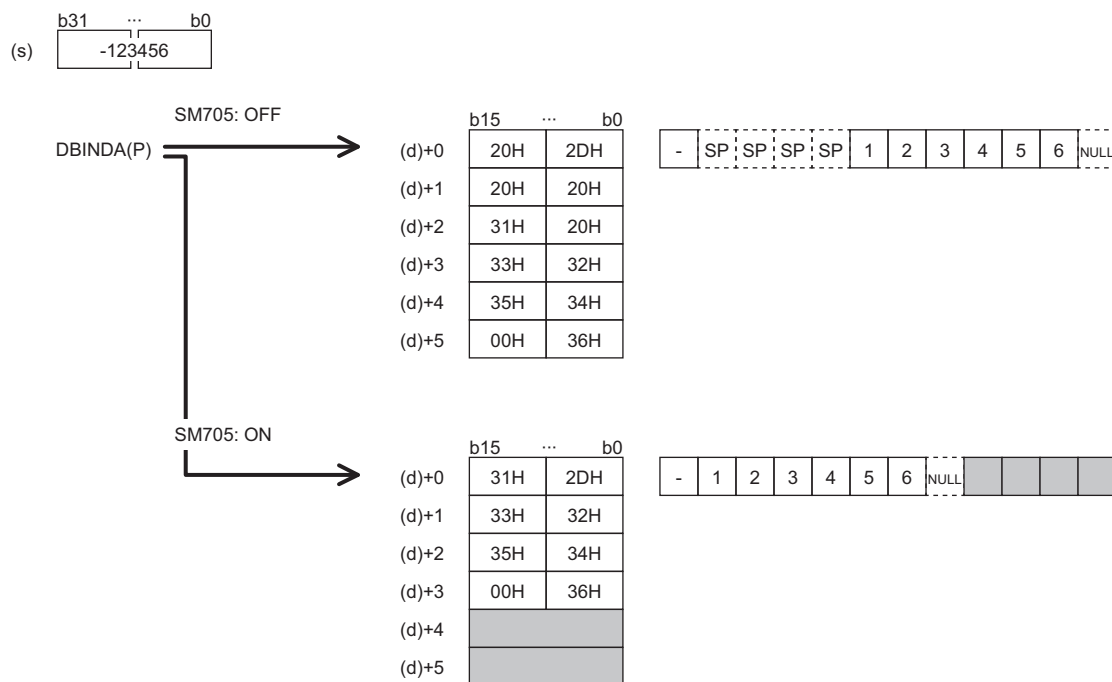
| Status of SM705 | Storage format of (d)                                              | Reference                                                                       |
|-----------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Off             | Data is stored in a fixed number of digits (a sign + 10 digits)    | Page 739 Operation of when SM705 (Number of conversion digits selection) is off |
| On              | Each digit is stored left-justified depending on the value of (s). | Page 740 Operation of when SM705 (Number of conversion digits selection) is on  |

### ■ Operation overview

The following figure shows the operation when SM705 (Number of conversion digits selection) is off and on.

**Ex.**

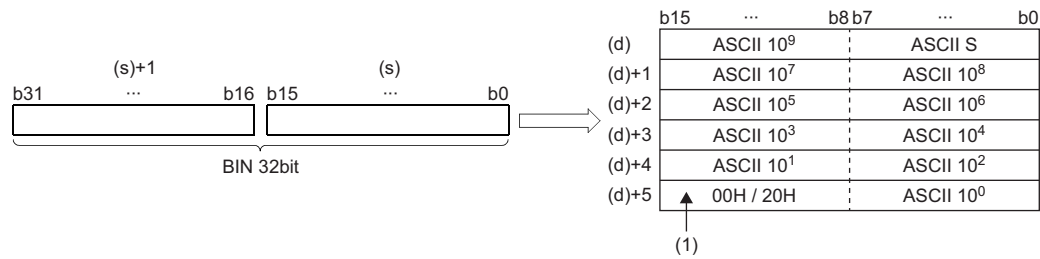
When the DBINDA(P) instruction is executed with a numeric value "-123456" stored in (s)



- When SM705 is off, the number of digits is fixed. The first character is a sign and it is 2DH(-) in the above example. (If (s) is 0 or positive, the first character is 20H (space).) The numeric part is right-justified. When the length of the numeric part is less than 10 digits, the ASCII code 20H (space) is stored for the ASCII code of the upper digit(s).
- When SM705 is on, data is left-justified. When the length of the numeric part is less than 10 digits, 00H is stored in the end.

## ■Operation of when SM705 (Number of conversion digits selection) is off

Decimal ASCII data is stored in a fixed number of digits in (d) to (d)+5.



ASCII S: Sign data of ASCII code\*<sup>1</sup>

ASCII 10<sup>9</sup>: Billions place of ASCII code\*<sup>2</sup>

ASCII 10<sup>8</sup>: Hundred-millions place of ASCII code\*<sup>3</sup>

⋮

ASCII 10<sup>1</sup>: Tens place of ASCII code\*<sup>4</sup>

ASCII 10<sup>0</sup>: Ones place of ASCII code

(1) 00H is stored in the upper byte of (d)+5 only when SM701 (Number of output characters selection) is off, and 20H (space) is stored when it is on.

\*<sup>1</sup> When the value is 0 or positive, 20H (space) is stored. When the value is negative, 2DH (-) is stored.

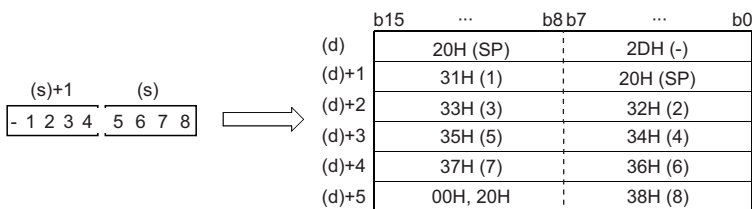
\*<sup>2</sup> When the length of the numeric part is 9 digits or less, 20H (space) is stored in ASCII 10<sup>9</sup>.

\*<sup>3</sup> When the length of the numeric part is 8 digits or less, 20H (space) is stored in ASCII 10<sup>8</sup>.

\*<sup>4</sup> When the length of the numeric part is 1 digit, 20H (space) is stored in ASCII 10<sup>1</sup>.

### Ex.

When -12345678 (signed) is specified in (s)



## ■Operation of when SM705 (Number of conversion digits selection) is on

Decimal ASCII data is stored right-justified in (d).

The following figures show an example of a value of (s) and a value stored in (d).

| Value of (s)                                                                                                                                    | Data of (d) to (d)+2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Value of (s) | Data of (d) to (d)+2            |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------------------|-------|-----|----|-----|-----------------------|---|---------------------------------|--|-------|-----------------------|---|-----------------------|--|-------|-----------------------|---|-----------------------|--|-------|-----------------------|---|-----------------------|--|-------|-----------------------|---|-----------------------|--|-------|----------------|---|-----------------------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|-----|----|-----|-----------------------|---|---------------------------------|--|-------|-----------------------|---|-----------------------|--|-------|-----------------------|---|-----------------------|--|-------|-----------------------|---|-----------------------|--|-------|-----------------------|---|-----------------------|--|-------|-----|--|--|--|
| <ul style="list-style-type: none"><li>• 0</li><li>• Positive value (1 digit in numeric part)</li></ul>                                          | <ul style="list-style-type: none"><li>• The upper byte of (d) is filled with 00H.</li><li>• (d)+1 and later remain unchanged.</li></ul> <table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td>00H</td><td>:</td><td>ASCII 10<sup>0</sup></td><td></td></tr><tr><td>(d)+1</td><td colspan="4"></td></tr><tr><td>(d)+2</td><td colspan="4"></td></tr><tr><td>(d)+3</td><td colspan="4"></td></tr><tr><td>(d)+4</td><td colspan="4"></td></tr><tr><td>(d)+5</td><td colspan="4"></td></tr></table>                                                                                                                                                                                                                                                                                                                                                              | b15          | ...                             | b8 b7 | ... | b0 | (d) | 00H                   | : | ASCII 10 <sup>0</sup>           |  | (d)+1 |                       |   |                       |  | (d)+2 |                       |   |                       |  | (d)+3 |                       |   |                       |  | (d)+4 |                       |   |                       |  | (d)+5 |                |   |                       |  | <ul style="list-style-type: none"><li>• Positive value (2 digits in numeric part)</li><li>• Negative value (1 digit in numeric part)</li></ul>                                                                                    | <ul style="list-style-type: none"><li>• (d)+1 is filled with 00H.</li><li>• (d)+2 and later remain unchanged.</li></ul> <table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td>ASCII 10<sup>0</sup></td><td>:</td><td>ASCII 10<sup>1</sup> / 2DH (-)</td><td></td></tr><tr><td>(d)+1</td><td colspan="4">00H</td></tr><tr><td>(d)+2</td><td colspan="4"></td></tr><tr><td>(d)+3</td><td colspan="4"></td></tr><tr><td>(d)+4</td><td colspan="4"></td></tr><tr><td>(d)+5</td><td colspan="4"></td></tr></table>                                                                                                                                                                                     | b15 | ... | b8 b7 | ... | b0 | (d) | ASCII 10 <sup>0</sup> | : | ASCII 10 <sup>1</sup> / 2DH (-) |  | (d)+1 | 00H                   |   |                       |  | (d)+2 |                       |   |                       |  | (d)+3 |                       |   |                       |  | (d)+4 |                       |   |                       |  | (d)+5 |     |  |  |  |
| b15                                                                                                                                             | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | b8 b7        | ...                             | b0    |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)                                                                                                                                             | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | :            | ASCII 10 <sup>0</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+1                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+2                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+3                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+4                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+5                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| b15                                                                                                                                             | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | b8 b7        | ...                             | b0    |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)                                                                                                                                             | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>1</sup> / 2DH (-) |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+1                                                                                                                                           | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+2                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+3                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+4                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+5                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| ⋮                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| <ul style="list-style-type: none"><li>• Positive value (9 digits in numeric part)</li><li>• Negative value (8 digits in numeric part)</li></ul> | <ul style="list-style-type: none"><li>• The upper byte of (d)+4 is filled with 00H.</li><li>• (d)+5 and later remain unchanged.</li></ul> <table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td>ASCII 10<sup>7</sup></td><td>:</td><td>ASCII 10<sup>8</sup> / 2DH (-)</td><td></td></tr><tr><td>(d)+1</td><td>ASCII 10<sup>5</sup></td><td>:</td><td>ASCII 10<sup>6</sup></td><td></td></tr><tr><td>(d)+2</td><td>ASCII 10<sup>3</sup></td><td>:</td><td>ASCII 10<sup>4</sup></td><td></td></tr><tr><td>(d)+3</td><td>ASCII 10<sup>1</sup></td><td>:</td><td>ASCII 10<sup>2</sup></td><td></td></tr><tr><td>(d)+4</td><td>00H</td><td>:</td><td>ASCII 10<sup>0</sup></td><td></td></tr><tr><td>(d)+5</td><td colspan="4"></td></tr></table>                                                                                                                  | b15          | ...                             | b8 b7 | ... | b0 | (d) | ASCII 10 <sup>7</sup> | : | ASCII 10 <sup>8</sup> / 2DH (-) |  | (d)+1 | ASCII 10 <sup>5</sup> | : | ASCII 10 <sup>6</sup> |  | (d)+2 | ASCII 10 <sup>3</sup> | : | ASCII 10 <sup>4</sup> |  | (d)+3 | ASCII 10 <sup>1</sup> | : | ASCII 10 <sup>2</sup> |  | (d)+4 | 00H                   | : | ASCII 10 <sup>0</sup> |  | (d)+5 |                |   |                       |  | <ul style="list-style-type: none"><li>• Positive value (10 digits in numeric part)</li><li>• Negative value (9 digits in numeric part)</li></ul>                                                                                  | <ul style="list-style-type: none"><li>• (d)+5 is filled with 00H.</li></ul> <table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td>ASCII 10<sup>8</sup></td><td>:</td><td>ASCII 10<sup>9</sup> / 2DH (-)</td><td></td></tr><tr><td>(d)+1</td><td>ASCII 10<sup>6</sup></td><td>:</td><td>ASCII 10<sup>7</sup></td><td></td></tr><tr><td>(d)+2</td><td>ASCII 10<sup>4</sup></td><td>:</td><td>ASCII 10<sup>5</sup></td><td></td></tr><tr><td>(d)+3</td><td>ASCII 10<sup>2</sup></td><td>:</td><td>ASCII 10<sup>3</sup></td><td></td></tr><tr><td>(d)+4</td><td>ASCII 10<sup>0</sup></td><td>:</td><td>ASCII 10<sup>1</sup></td><td></td></tr><tr><td>(d)+5</td><td colspan="4">00H</td></tr></table> | b15 | ... | b8 b7 | ... | b0 | (d) | ASCII 10 <sup>8</sup> | : | ASCII 10 <sup>9</sup> / 2DH (-) |  | (d)+1 | ASCII 10 <sup>6</sup> | : | ASCII 10 <sup>7</sup> |  | (d)+2 | ASCII 10 <sup>4</sup> | : | ASCII 10 <sup>5</sup> |  | (d)+3 | ASCII 10 <sup>2</sup> | : | ASCII 10 <sup>3</sup> |  | (d)+4 | ASCII 10 <sup>0</sup> | : | ASCII 10 <sup>1</sup> |  | (d)+5 | 00H |  |  |  |
| b15                                                                                                                                             | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | b8 b7        | ...                             | b0    |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)                                                                                                                                             | ASCII 10 <sup>7</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>8</sup> / 2DH (-) |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+1                                                                                                                                           | ASCII 10 <sup>5</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>6</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+2                                                                                                                                           | ASCII 10 <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>4</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+3                                                                                                                                           | ASCII 10 <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>2</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+4                                                                                                                                           | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | :            | ASCII 10 <sup>0</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+5                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| b15                                                                                                                                             | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | b8 b7        | ...                             | b0    |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)                                                                                                                                             | ASCII 10 <sup>8</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>9</sup> / 2DH (-) |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+1                                                                                                                                           | ASCII 10 <sup>6</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>7</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+2                                                                                                                                           | ASCII 10 <sup>4</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>5</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+3                                                                                                                                           | ASCII 10 <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>3</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+4                                                                                                                                           | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>1</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+5                                                                                                                                           | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                                 |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| Negative value (10 digits in numeric part)                                                                                                      | <ul style="list-style-type: none"><li>• 00H is stored in the upper byte (1) of (d)+5 when SM701 (Number of output characters selection) is off, and 20H (space) is stored when it is on.</li></ul> <table><tr><td>b15</td><td>...</td><td>b8 b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td>ASCII 10<sup>9</sup></td><td>:</td><td>2DH (-)</td><td></td></tr><tr><td>(d)+1</td><td>ASCII 10<sup>7</sup></td><td>:</td><td>ASCII 10<sup>8</sup></td><td></td></tr><tr><td>(d)+2</td><td>ASCII 10<sup>5</sup></td><td>:</td><td>ASCII 10<sup>6</sup></td><td></td></tr><tr><td>(d)+3</td><td>ASCII 10<sup>3</sup></td><td>:</td><td>ASCII 10<sup>4</sup></td><td></td></tr><tr><td>(d)+4</td><td>ASCII 10<sup>1</sup></td><td>:</td><td>ASCII 10<sup>2</sup></td><td></td></tr><tr><td>(d)+5</td><td>↑<br/>00H / 20H</td><td>:</td><td>ASCII 10<sup>0</sup></td><td></td></tr></table> <p>(1)</p> | b15          | ...                             | b8 b7 | ... | b0 | (d) | ASCII 10 <sup>9</sup> | : | 2DH (-)                         |  | (d)+1 | ASCII 10 <sup>7</sup> | : | ASCII 10 <sup>8</sup> |  | (d)+2 | ASCII 10 <sup>5</sup> | : | ASCII 10 <sup>6</sup> |  | (d)+3 | ASCII 10 <sup>3</sup> | : | ASCII 10 <sup>4</sup> |  | (d)+4 | ASCII 10 <sup>1</sup> | : | ASCII 10 <sup>2</sup> |  | (d)+5 | ↑<br>00H / 20H | : | ASCII 10 <sup>0</sup> |  | ASCII 10 <sup>9</sup> : Billions place of ASCII code<br>ASCII 10 <sup>8</sup> : Hundred-millions place of ASCII code<br>⋮<br>ASCII 10 <sup>1</sup> : Tens place of ASCII code<br>ASCII 10 <sup>0</sup> : Ones place of ASCII code |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| b15                                                                                                                                             | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | b8 b7        | ...                             | b0    |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)                                                                                                                                             | ASCII 10 <sup>9</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | 2DH (-)                         |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+1                                                                                                                                           | ASCII 10 <sup>7</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>8</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+2                                                                                                                                           | ASCII 10 <sup>5</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>6</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+3                                                                                                                                           | ASCII 10 <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>4</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+4                                                                                                                                           | ASCII 10 <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :            | ASCII 10 <sup>2</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |
| (d)+5                                                                                                                                           | ↑<br>00H / 20H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | :            | ASCII 10 <sup>0</sup>           |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                |   |                       |  |                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |     |     |       |     |    |     |                       |   |                                 |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |                       |   |                       |  |       |     |  |  |  |

- When the number of operation digits is less than the maximum number of digits (a sign + 10 digits), 00H is stored in the end of the string regardless of the status (on/off) of SM701 (Number of output characters selection). If the end of the string is the lower byte, 00H is also stored in the upper byte.
- When the number of operation digits is equal to the maximum number of digits (a sign + 10 digits), 00H is stored in the upper byte of (d)+5 if SM701 is off. 20H (space) is stored in the upper byte of (d)+5 if SM701 is on.

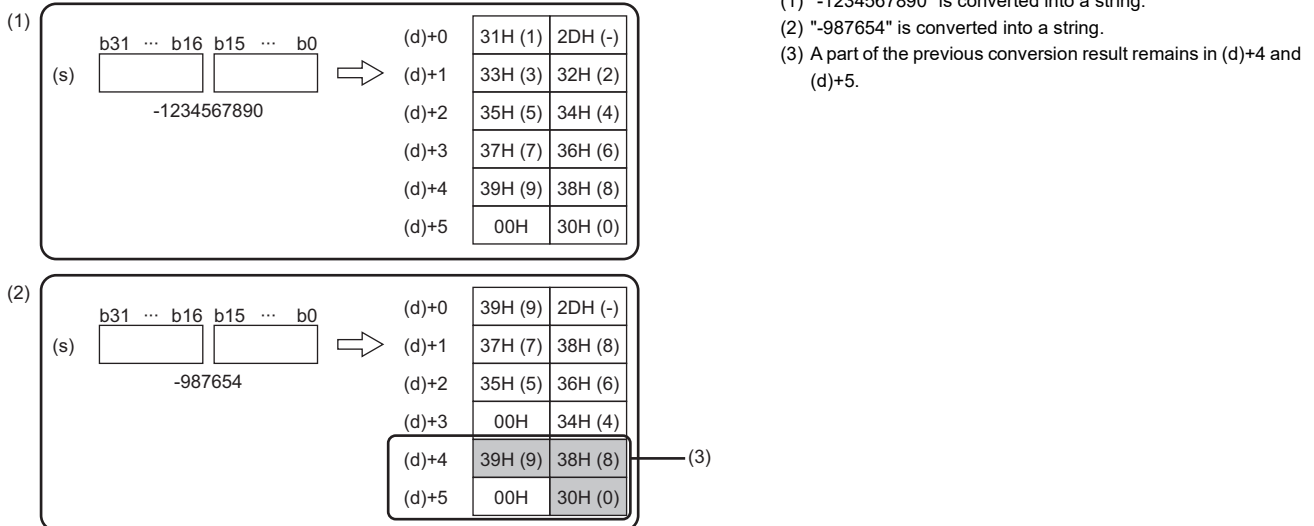
## Operation error

There is no operation error.

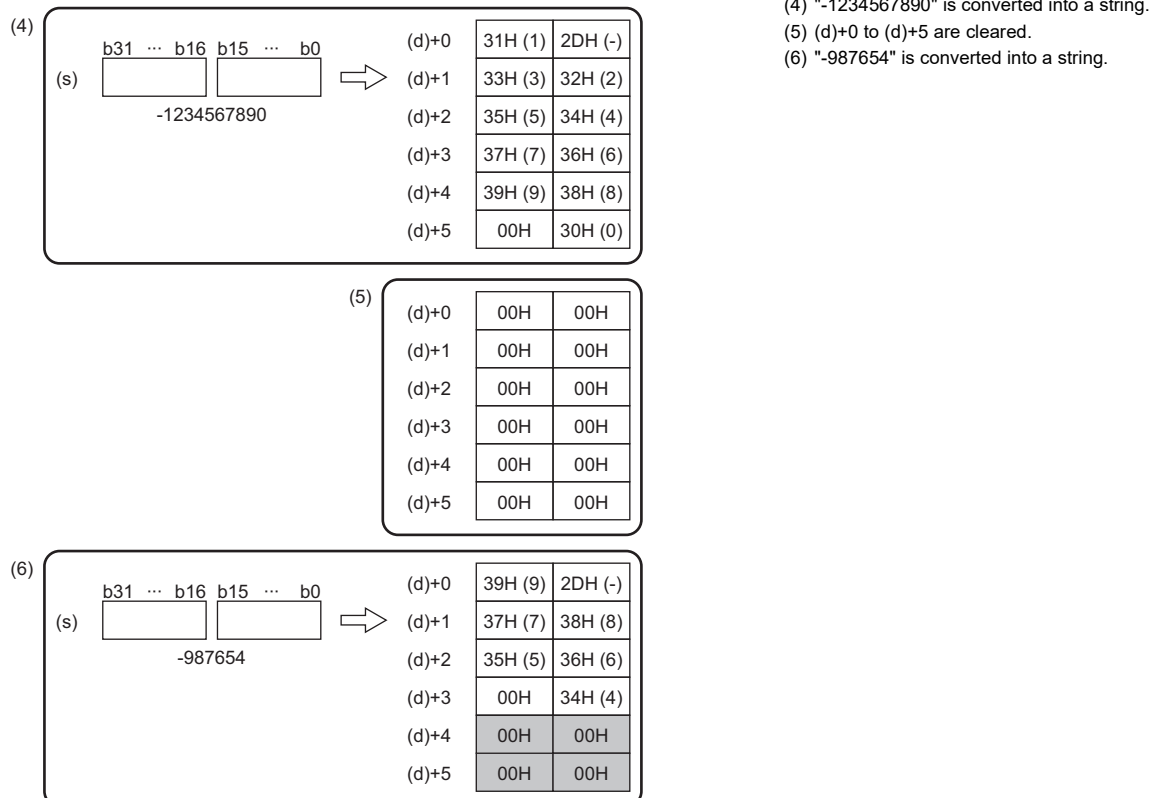
## Precautions

When SM705 (Number of conversion digits selection) is on, the operation result is stored in (d) for the effective number of digits. Therefore, when the DBINDA(P)(\_U) instruction is executed successively and the operation result for each execution is stored in the same device, a part of the previous operation result may not be overwritten by the succeeding result and can remain in (d).

[Example] Executing the DBINDA(P) instruction when (s) is "-1234567890" and then executing another DBINDA(P) instruction when (s) is "-987654"



To avoid this, create a program to clear the entire data storage areas (d)+0 to (d)+5 before executing the DBINDA(P)(\_U) instruction.



# Converting 16-bit binary data to hexadecimal ASCII

## BINHA(P)

These instructions convert 16-bit binary data to the hexadecimal ASCII code.

| Ladder | ST                                          |
|--------|---------------------------------------------|
|        | ENO:=BINHA(EN,s,d);<br>ENO:=BINHAP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BINHA       |                     |
| BINHAP      |                     |

### Setting data

### Description, range, data type

| Operand | Description                                    | Range           | Data type            | Data type (label) |
|---------|------------------------------------------------|-----------------|----------------------|-------------------|
| (s)     | Binary data used for ASCII conversion          | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Start device for storing the conversion result | —               | String               | ANYSTRING_SINGLE  |
| EN      | Execution condition                            | —               | Bit                  | BOOL              |
| ENO     | Execution result                               | —               | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |



## Processing details

- These instructions convert the digit in hexadecimal notation of the 16-bit binary data in the device specified by (s) to the ASCII code, and store the converted data in the device number specified by (d) and later.
- The format of the hexadecimal ASCII data to be stored in (d) depends on the status of SM705 (Number of conversion digits selection).

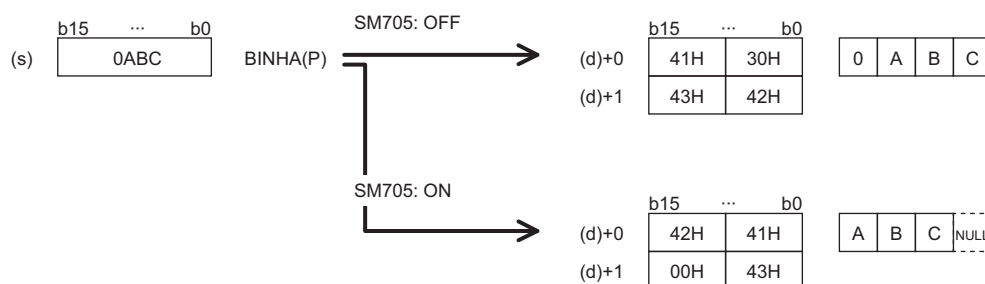
| Status of SM705 | Storage format of (d)                                              | Reference                                                                       |
|-----------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Off             | Data is stored in a fixed number of digits (4 digits)              | Page 744 Operation of when SM705 (Number of conversion digits selection) is off |
| On              | Each digit is stored left-justified depending on the value of (s). | Page 744 Operation of when SM705 (Number of conversion digits selection) is on  |

### ■ Operation overview

The following figure shows the operation when SM705 (Number of conversion digits selection) is off and on.

**Ex.**

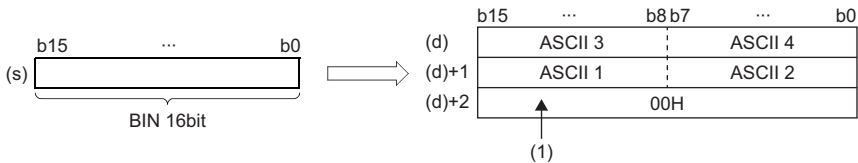
When the BINHA(P) instruction is executed with the 16-bit binary data "0ABCH" stored in (s)



- When SM705 is off, the number of digits is fixed. Four digits of "0ABC" are converted into ASCII data and stored.
- When SM705 is on, data is left-justified. "0ABC" with the leading "0" omitted ("ABC") are converted into ASCII data and stored, and 00H is stored in the end.

■Operation of when SM705 (Number of conversion digits selection) is off

Hexadecimal ASCII data is stored in a fixed number of digits (4 digits) in (d).



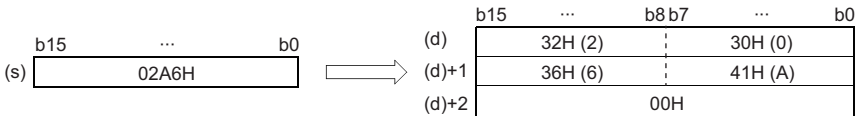
ASCII □: ASCII code (□th digit)

(1) 00H is stored in (d)+2 when SM701 (Number of output characters selection) is off. When it is on, the value remains unchanged.

- The operation result to be stored in the device specified by (d) is processed as a 4-digit hexadecimal number. Therefore, 0 at the left side of the effective number of digits is processed as "0". (Zero padding)

Ex.

When 02A6H is stored in the device specified by (s)



■Operation of when SM705 (Number of conversion digits selection) is on

Hexadecimal ASCII data for the number of digits (up to 4 digits) without the leftmost "0" in the effective digits is stored right-justified in (d).

The following figures show an example of a value of (s) and a value stored in (d).

| Value of (s) | Data of (d) to (d)+1                                                                                                                                                                                                         | Value of (s)   | Data of (d) to (d)+1                                                                                                                                                                                                                                                                  |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0H to FH     | <ul style="list-style-type: none"><li>• The upper byte of (d) is filled with 00H.</li><li>• (d)+1 and later remain unchanged.</li></ul> <div><div>b15 ... b8 b7 ... b0</div><div>(d) 00H ASCII 1</div><div>(d)+1</div></div> | 10H to FFH     | <div>(d)+1 is filled with 00H.</div> <div><div>b15 ... b8 b7 ... b0</div><div>(d) ASCII 1 ASCII 2</div><div>(d)+1 00H</div></div>                                                                                                                                                     |
| 100H to FFFH | <div>The upper byte of (d)+1 are filled with 00H.</div> <div><div>b15 ... b8 b7 ... b0</div><div>(d) ASCII 2 ASCII 3</div><div>(d)+1 00H ASCII 1</div></div>                                                                 | 1000H to FFFFH | <div>(1) (d)+2 is filled with 00H when SM701 (Number of output characters selection) is off. (d)+2 remains unchanged if SM701 is on.</div> <div><div>b15 ... b8 b7 ... b0</div><div>(d) ASCII 3 ASCII 4</div><div>(d)+1 ASCII 1 ASCII 2</div><div>(d)+2 00H</div><div>(1)</div></div> |

ASCII □: ASCII code (□th digit)

- When the number of digits is less than the maximum number of digits (4 digits), 00H is stored in the end of the string regardless of the status (on/off) of SM701 (Number of output characters selection). If the end of the string is the lower byte, 00H is also stored in the upper byte.
- When the number of digits is equal to the maximum number of digits (4 digits), 00H is stored in (d)+2 when SM701 is off. (d)+2 remains unchanged if SM701 is on.

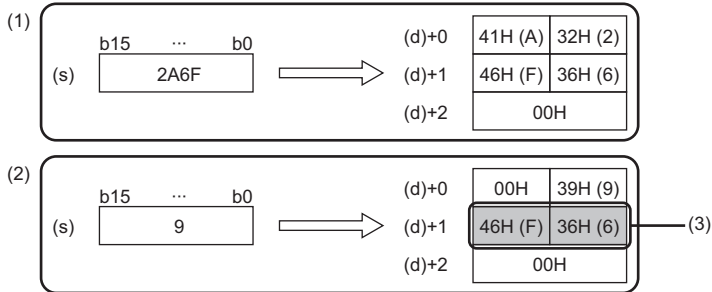
Operation error

There is no operation error.

## Precautions

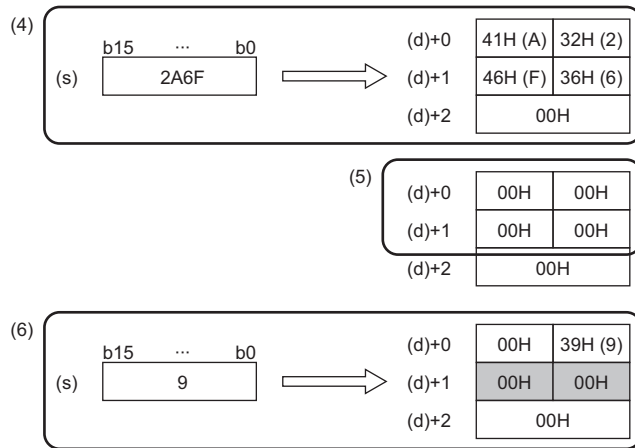
When SM705 (Number of conversion digits selection) is on, the operation result is stored in (d) for the effective number of digits. Therefore, when the BINHA(P) instruction is executed successively and the operation result for each execution is stored in the same device, a part of the previous operation result may not be overwritten by the succeeding result and can remain in (d).

[Example] Executing the BINHA(P) instruction when (s) is "2A6F" and then executing another BINHA(P) instruction when (s) is "9"



- (1) "2A6F" is converted into a string.
- (2) "9" is converted into a string.
- (3) A part of the previous conversion result remains in (d)+1.

To avoid this, create a program to clear the entire data storage areas (d)+0 and (d)+1 before executing the BINHA(P) instruction.

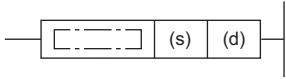


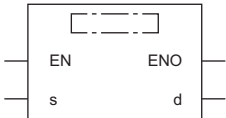
- (4) "2A6F" is converted into a string.
- (5) (d)+0 to (d)+1 are cleared.
- (6) "9" is converted into a string.

# Converting 32-bit binary data to hexadecimal ASCII

## DBINHA(P)

These instructions convert 32-bit binary data to the hexadecimal ASCII code.

| Ladder                                                                            | ST                                            |
|-----------------------------------------------------------------------------------|-----------------------------------------------|
|  | ENO:=DBINHA(EN,s,d);<br>ENO:=DBINHAP(EN,s,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DBINHA      |  |
| DBINHAP     |  |

### Setting data

### Description, range, data type

| Operand | Description                                    | Range                     | Data type            | Data type (label) |
|---------|------------------------------------------------|---------------------------|----------------------|-------------------|
| (s)     | Binary data used for ASCII conversion          | -2147483648 to 2147483647 | 32-bit signed binary | ANY32             |
| (d)     | Start device for storing the conversion result | —                         | String               | ANYSTRING_SINGLE  |
| EN      | Execution condition                            | —                         | Bit                  | BOOL              |
| ENO     | Execution result                               | —                         | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the digit at each place in hexadecimal notation of the 32-bit binary data specified by (s) to the ASCII code, and store the converted data in the device number specified by (d) and later.
- The format of the decimal ASCII data to be stored in (d) depends on the status of SM705 (Number of conversion digits selection).

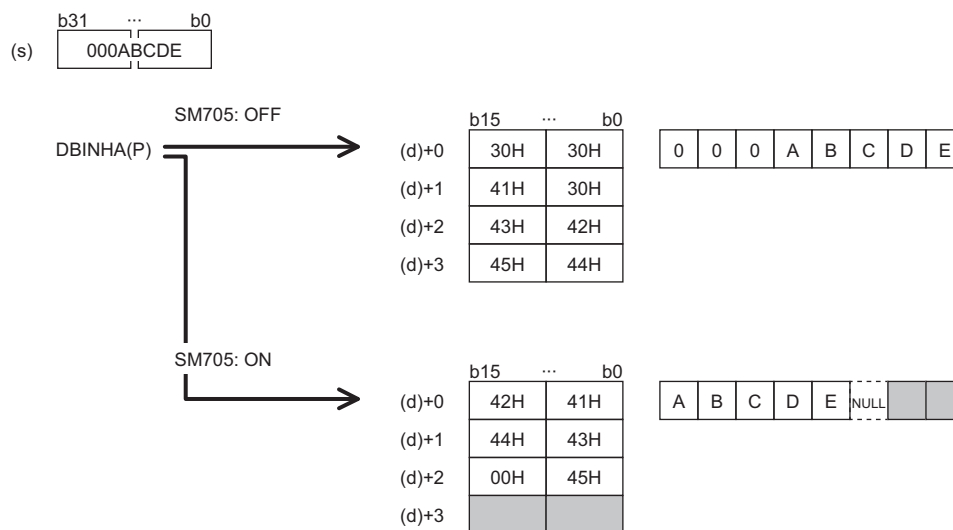
| Status of SM705 | Storage format of (d)                                              | Reference                                                                       |
|-----------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Off             | Data is stored in a fixed number of digits (8 digits)              | Page 748 Operation of when SM705 (Number of conversion digits selection) is off |
| On              | Each digit is stored left-justified depending on the value of (s). | Page 748 Operation of when SM705 (Number of conversion digits selection) is on  |

### ■ Operation overview

The following figure shows the operation when SM705 (Number of conversion digits selection) is off and on.

**Ex.**

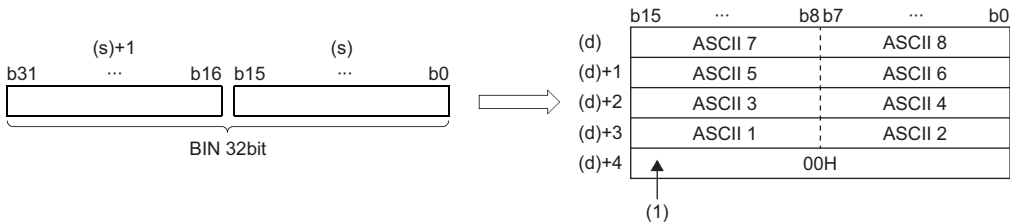
When the DBINHA(P) instruction is executed with a 32-bit binary data "000ABCDEH" stored in (s)



- When SM705 is off, the number of digits is fixed. Eight digits of "000ABCDE" are converted into ASCII data and stored.
- When SM705 is on, data is left-justified. The effective digits "000ABCDE" with the leading "0"s omitted ("ABCDE") are converted into ASCII data and stored, and 00H is stored in the end.

■Operation of when SM705 (Number of conversion digits selection) is off

Hexadecimal ASCII data is stored in a fixed number of digits (8 digits) in (d) to (d)+3.



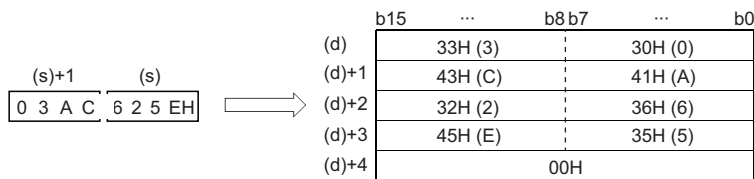
ASCII □: ASCII code (□th digit)

(1) 00H is stored in (d)+4 when SM701 (Number of output characters selection) is off. When it is on, the value remains unchanged.

- The operation result to be stored in the device specified by (d) is processed as an 8-digit hexadecimal number. Therefore, 0 at the left side of the effective number of digits is processed as "0". (Zero padding)

**Ex.**

When 03AC625EH is stored in the device specified by (s)



■Operation of when SM705 (Number of conversion digits selection) is on

Hexadecimal ASCII data for the number of digits (up to 8 digits) without the leftmost "0" in the effective digits is stored right-justified in (d).

The following figures show an example of a value of (s) and a value stored in (d).

| Value of (s)          | Data of (d) to (d)+3                                                                                                                                                                                                                                                                                                                                                          | Value of (s) | Data of (d) to (d)+3 |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------|---------|-------|---------|---------|-------|---------|---------|-------|-----|---------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------|---------|-------|---------|---------|-------|---------|---------|-------|---------|---------|-------|-----|--|
| 0H to FH              | <ul style="list-style-type: none"><li>• The upper byte of (d) is filled with 00H.</li><li>• (d)+1 and later remain unchanged.</li></ul> <div><div>b15 ... b8 b7 ... b0</div><table><tr><td>(d)</td><td>00H</td><td>ASCII 1</td></tr><tr><td>(d)+1</td><td></td><td></td></tr><tr><td>(d)+2</td><td></td><td></td></tr><tr><td>(d)+3</td><td></td><td></td></tr></table></div> | (d)          | 00H                  | ASCII 1 | (d)+1 |         |         | (d)+2 |         |         | (d)+3 |     |         | 10H to FFH             | <ul style="list-style-type: none"><li>• (d)+1 is filled with 00H.</li><li>• (d)+2 and later remain unchanged.</li></ul> <div><div>b15 ... b8 b7 ... b0</div><table><tr><td>(d)</td><td>ASCII 1</td><td>ASCII 2</td></tr><tr><td>(d)+1</td><td>00H</td><td></td></tr><tr><td>(d)+2</td><td></td><td></td></tr><tr><td>(d)+3</td><td></td><td></td></tr></table></div>                                                                                                                                                                                 | (d) | ASCII 1 | ASCII 2 | (d)+1 | 00H     |         | (d)+2 |         |         | (d)+3 |         |         |       |     |  |
| (d)                   | 00H                                                                                                                                                                                                                                                                                                                                                                           | ASCII 1      |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+1                 |                                                                                                                                                                                                                                                                                                                                                                               |              |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+2                 |                                                                                                                                                                                                                                                                                                                                                                               |              |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+3                 |                                                                                                                                                                                                                                                                                                                                                                               |              |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)                   | ASCII 1                                                                                                                                                                                                                                                                                                                                                                       | ASCII 2      |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+1                 | 00H                                                                                                                                                                                                                                                                                                                                                                           |              |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+2                 |                                                                                                                                                                                                                                                                                                                                                                               |              |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+3                 |                                                                                                                                                                                                                                                                                                                                                                               |              |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| ⋮                     |                                                                                                                                                                                                                                                                                                                                                                               |              |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| 1000000H to FFFFFFFFH | <ul style="list-style-type: none"><li>• The upper byte of (d)+3 is filled with 00H.</li></ul> <div><div>b15 ... b8 b7 ... b0</div><table><tr><td>(d)</td><td>ASCII 6</td><td>ASCII 7</td></tr><tr><td>(d)+1</td><td>ASCII 4</td><td>ASCII 5</td></tr><tr><td>(d)+2</td><td>ASCII 2</td><td>ASCII 3</td></tr><tr><td>(d)+3</td><td>00H</td><td>ASCII 1</td></tr></table></div> | (d)          | ASCII 6              | ASCII 7 | (d)+1 | ASCII 4 | ASCII 5 | (d)+2 | ASCII 2 | ASCII 3 | (d)+3 | 00H | ASCII 1 | 10000000H to FFFFFFFFH | <p>(1) (d)+4 is filled with 00H when SM701 (Number of output characters selection) is off. (d)+4 does not change if SM701 (Number of output characters selection) is on.</p> <div><div>b15 ... b8 b7 ... b0</div><table><tr><td>(d)</td><td>ASCII 7</td><td>ASCII 8</td></tr><tr><td>(d)+1</td><td>ASCII 5</td><td>ASCII 6</td></tr><tr><td>(d)+2</td><td>ASCII 3</td><td>ASCII 4</td></tr><tr><td>(d)+3</td><td>ASCII 1</td><td>ASCII 2</td></tr><tr><td>(d)+4</td><td colspan="2">00H</td></tr></table><div><div>↑</div><div>(1)</div></div></div> | (d) | ASCII 7 | ASCII 8 | (d)+1 | ASCII 5 | ASCII 6 | (d)+2 | ASCII 3 | ASCII 4 | (d)+3 | ASCII 1 | ASCII 2 | (d)+4 | 00H |  |
| (d)                   | ASCII 6                                                                                                                                                                                                                                                                                                                                                                       | ASCII 7      |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+1                 | ASCII 4                                                                                                                                                                                                                                                                                                                                                                       | ASCII 5      |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+2                 | ASCII 2                                                                                                                                                                                                                                                                                                                                                                       | ASCII 3      |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+3                 | 00H                                                                                                                                                                                                                                                                                                                                                                           | ASCII 1      |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)                   | ASCII 7                                                                                                                                                                                                                                                                                                                                                                       | ASCII 8      |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+1                 | ASCII 5                                                                                                                                                                                                                                                                                                                                                                       | ASCII 6      |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+2                 | ASCII 3                                                                                                                                                                                                                                                                                                                                                                       | ASCII 4      |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+3                 | ASCII 1                                                                                                                                                                                                                                                                                                                                                                       | ASCII 2      |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |
| (d)+4                 | 00H                                                                                                                                                                                                                                                                                                                                                                           |              |                      |         |       |         |         |       |         |         |       |     |         |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |         |         |       |         |         |       |         |         |       |         |         |       |     |  |

ASCII □: ASCII code (□th digit)

- When the number of digits is less than the maximum number of digits (8 digits), 00H is stored in the end of the string regardless of the status (on/off) of SM701 (Number of output characters selection). If the end of the string is the lower byte, 00H is also stored in the upper byte.
- When the number of digits is equal to the maximum number of digits (8 digits), 00H is stored in (d)+4 when SM701 (Number of output characters selection) is off. (d)+4 does not change if SM701 (Number of output characters selection) is on.

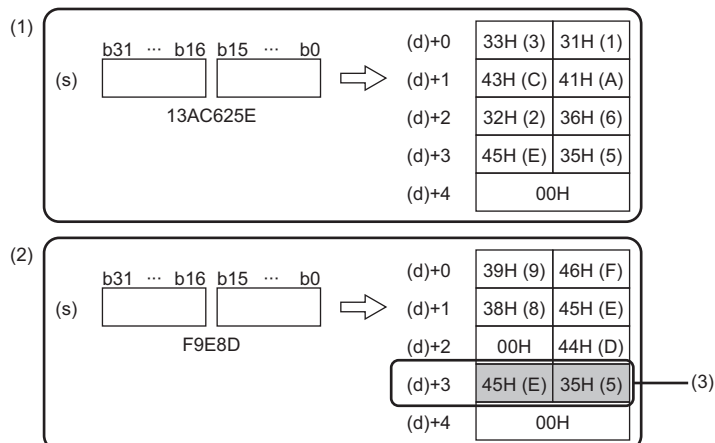
## Operation error

There is no operation error.

## Precautions

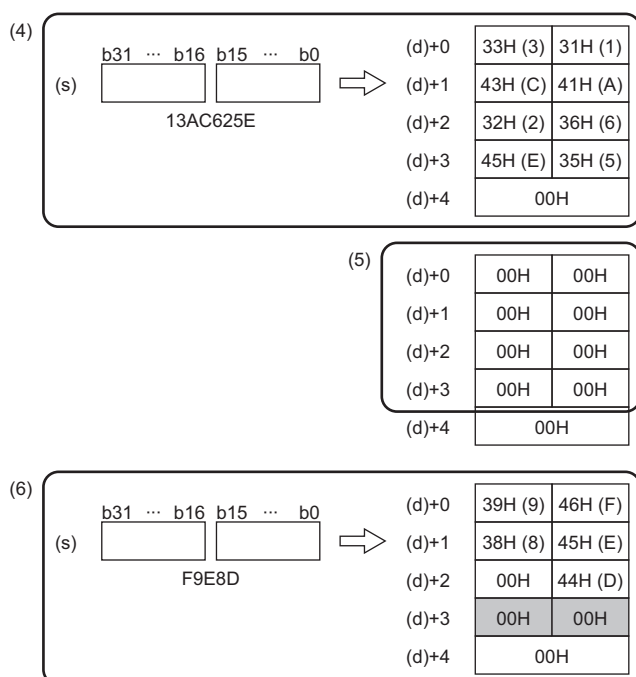
When SM705 (Number of conversion digits selection) is on, the operation result is stored in (d) for the effective number of digits. Therefore, when the DBINHA(P) instruction is executed successively and the operation result for each execution is stored in the same device, a part of the previous operation result may not be overwritten by the succeeding result and can remain in (d).

[Example] Executing the DBINHA(P) instruction when (s) is "13AC625E" and then executing another DBINHA(P) instruction when (s) is "F9E8D"



- (1) "13AC625E" is converted into a string.
- (2) "F9E8D" is converted into a string.
- (3) A part of the previous conversion result remains in (d)+3.

To avoid this, create a program to clear the entire data storage areas (d)+0 to (d)+3 before executing the DBINHA(P) instruction.



- (4) "13AC625E" is converted into a string.
- (5) (d)+0 to (d)+3 are cleared.
- (6) "F9E8D" is converted into a string.

# Converting 16-bit binary data to string data

## STR(P)(\_U)

These instructions convert 16-bit binary data to a string by adding a decimal point to the specified place of the data.

| Ladder | ST                                              |                                                     |
|--------|-------------------------------------------------|-----------------------------------------------------|
|        | ENO:=STR(EN,s1,s2,d);<br>ENO:=STRP(EN,s1,s2,d); | ENO:=STR_U(EN,s1,s2,d);<br>ENO:=STRP_U(EN,s1,s2,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction    | Execution condition |
|----------------|---------------------|
| STR<br>STR_U   |                     |
| STRP<br>STRP_U |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                                     | Range           | Data type              | Data type (label)                        |
|---------|---------------------------------------------------------------------------------|-----------------|------------------------|------------------------------------------|
| (s1)    | Start device where the number of digits of the conversion target data is stored | —               | 16-bit signed binary   | ANY16_S_ARRAY<br>(Number of elements: 2) |
|         |                                                                                 |                 | 16-bit unsigned binary | ANY16_U_ARRAY<br>(Number of elements: 2) |
| (s2)    | Conversion target data                                                          | -32768 to 32767 | 16-bit signed binary   | ANY16_S                                  |
|         |                                                                                 | 0 to 65535      | 16-bit unsigned binary | ANY16_U                                  |
| (d)     | Start device for storing the converted string                                   | —               | String                 | ANYSTRING_SINGLE                         |
| EN      | Execution condition                                                             | —               | Bit                    | BOOL                                     |
| ENO     | Execution result                                                                | —               | Bit                    | BOOL                                     |

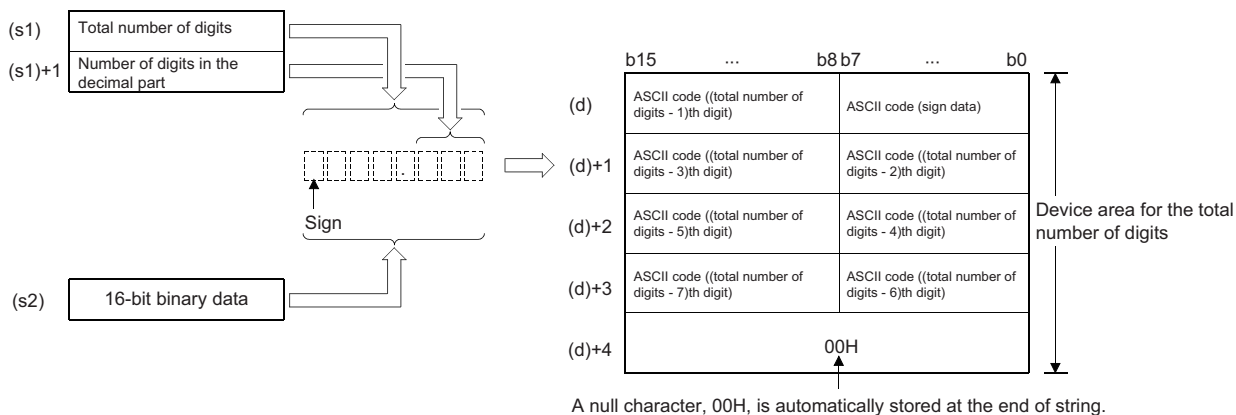
### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —      |



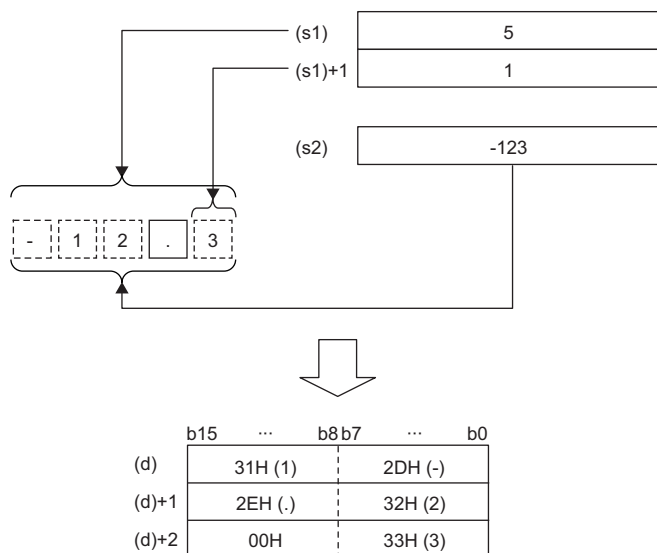
## Processing details

- These instructions add a decimal point to the 16-bit binary data in the device specified by (s2) at the location specified by (s1), convert the data to string data, and store the converted data in the device areas specified by (d) and later.



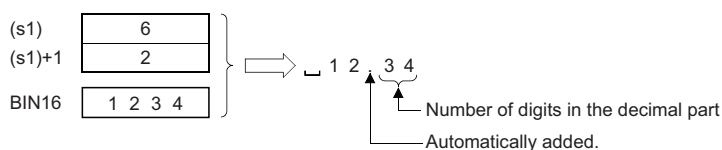
### Ex.

When converting data "-123" in (s2) into a string assuming that the number of decimal places is one ("-12.3")

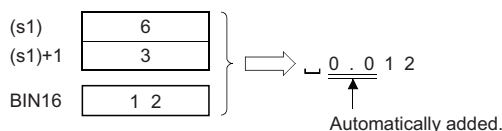


- When storing the decimal part in (d), the total number of digits that can be specified by (s1) is 4 to 8. The number of digits in the decimal part that can be specified by (s1)+1 is 1 to 5. Note that the number of digits in the decimal part must be equal to or smaller than the total number of digits minus 3.
- When not storing the decimal part in (d), the total number of digits that can be specified by (s1) is 2 to 8. The number of digits in the decimal part that can be specified by (s1)+1 cannot be set.

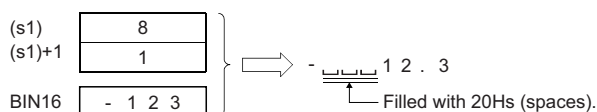
- The converted string data are stored in the device areas specified by (d) and later as shown below.
- As sign data, "20H" (space) is stored if the 16-bit binary data is positive, and "2DH" (-) is stored if the data is negative.
- If the number of digits in the decimal part is set to other than 0, "2EH" (.) is automatically stored at the position before the specified number of digits. If the number of digits in the decimal part is 0, "2EH" (.) is not stored.



- If the specified number of digits in the decimal part is greater than the number of digits of the 16-bit binary data, 0s are automatically added and the data is regarded as "0.□□□□".



- If the total number of digits excluding the sign and the decimal point is greater than the number of digits of the 16-bit binary data, "20H" (space) is stored between the sign and the numeric value. If the number of digits of the 16-bit binary data is greater, an error occurs.



- The value "00H" is automatically stored at the end of the converted string.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | Invalid data that cannot be converted is input to (s1). <ul style="list-style-type: none"> <li>• The specified total number of digits is out of the range, 2 to 8.</li> <li>• The specified number of digits in the decimal part of (s1)+1 is out of the range, 0 to 5.</li> <li>• When the specified number of digits in the decimal part of (s1)+1 is in the range 1 to 5, the relationship between the total number of digits specified by (s1) and the number of digits in the decimal part specified by (s1)+1 does not satisfy the following.<br/>               (Total number of digits)-3≥Number of digits in the decimal part             </li> <li>• The number of digits specified by (s1) is smaller than the number of digits plus 2 of the 16-bit binary data specified by (s2).<br/>               [Number of digits in (s1)] &lt; [Number of digits of 16-bit binary data excluding the sign in (s2) + Number of digits in the sign (+ or -) + Number of digits of decimal point (.)]             </li> </ul> |
| 3286H            | The entire string that was converted in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

# Converting 32-bit binary data to string data

16

## DSTR(P)(\_U)

These instructions convert 32-bit binary data to a string by adding a decimal point to the specified place of the data.

| Ladder | ST                                                |                                                       |
|--------|---------------------------------------------------|-------------------------------------------------------|
|        | ENO:=DSTR(EN,s1,s2,d);<br>ENO:=DSTRP(EN,s1,s2,d); | ENO:=DSTR_U(EN,s1,s2,d);<br>ENO:=DSTRP_U(EN,s1,s2,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction      | Execution condition |
|------------------|---------------------|
| DSTR<br>DSTR_U   |                     |
| DSTRP<br>DSTRP_U |                     |

### Setting data

### Description, range, data type

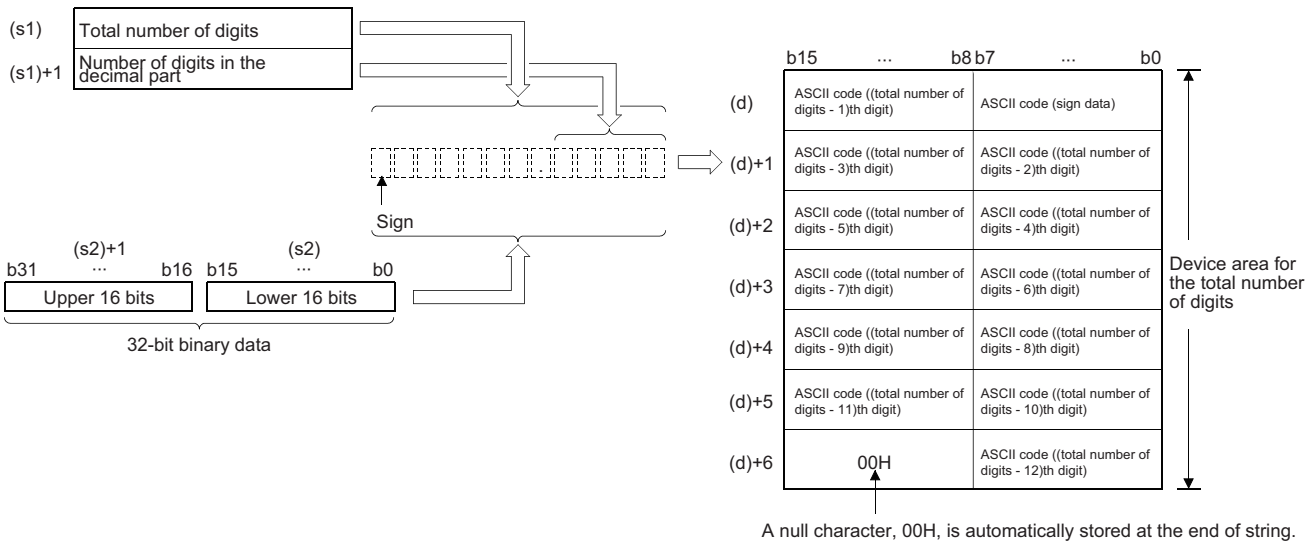
| Operand | Description                                   | Range                     | Data type              | Data type (label)                        |
|---------|-----------------------------------------------|---------------------------|------------------------|------------------------------------------|
| (s1)    | DSTR(P)                                       | —                         | 16-bit signed binary   | ANY16_S_ARRAY<br>(Number of elements: 2) |
|         | DSTR(P)_U                                     |                           | 16-bit unsigned binary | ANY16_U_ARRAY<br>(Number of elements: 2) |
| (s2)    | DSTR(P)                                       | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32_S                                  |
|         | DSTR(P)_U                                     | 0 to 4294967295           | 32-bit unsigned binary | ANY32_U                                  |
| (d)     | Start device for storing the converted string |                           | String                 | ANYSTRING_SINGLE                         |
| EN      | Execution condition                           |                           | Bit                    | BOOL                                     |
| ENO     | Execution result                              |                           | Bit                    | BOOL                                     |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○         | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —      |

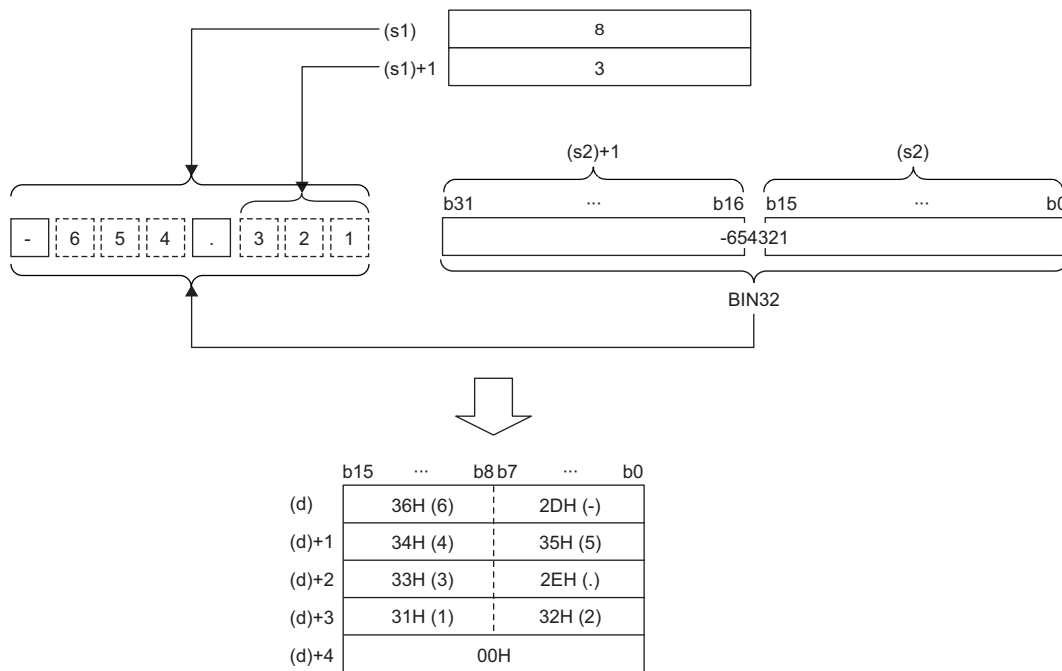
## Processing details

- These instructions add a decimal point to the 32-bit binary data in the device specified by (s2) at the location specified by (s1), convert the data to string data, and store the converted data in the device areas specified by (d) and later.



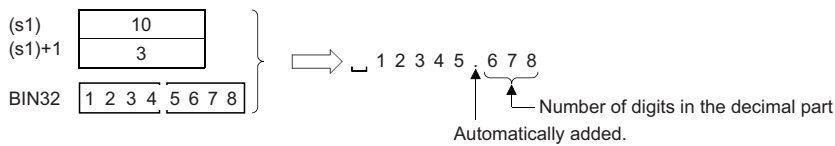
**Ex.**

When converting data "-654321" in (s2) into a string assuming that the number of decimal places is three ("-654.321")

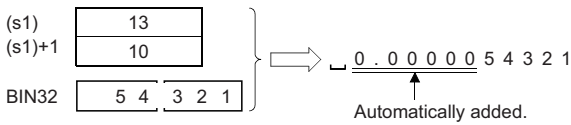


- When storing the decimal part in (d), the total number of digits that can be specified by (s1) is 4 to 13. The number of digits in the decimal part that can be specified by (s1)+1 is 1 to 10. Note that the number of digits in the decimal part must be equal to or smaller than the total number of digits minus 3.
- When not storing the decimal part in (d), the total number of digits that can be specified by (s1) is 2 to 13. The number of digits in the decimal part that can be specified by (s1)+1 cannot be set.

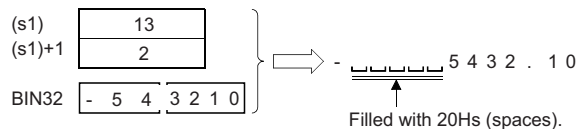
- The converted string data are stored in the device areas specified by (d) and later as shown below.
- As sign data, 20H (space) is stored if the 32-bit binary data is positive, and 2DH (-) is stored if the data is negative.
- If the number of digits in the decimal part is set to other than 0, "2EH" (.) is automatically stored at the position before the specified number of digits. If the number of digits in the decimal part is 0, "2EH" (.) is not stored.



- If the specified number of digits in the decimal part is greater than the number of digits of the 32-bit binary data, 0s are automatically added and the data is regarded as "0.□□□□".



- If the total number of digits excluding the sign and the decimal point is greater than the number of digits of the 32-bit binary data, 20H (space) is stored between the sign and the numeric value. If the number of digits of the 32-bit binary data is greater, an error occurs.



- The value "00H" is automatically stored at the end of the converted string.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | <p>Invalid data that cannot be converted is input to (s1).</p> <ul style="list-style-type: none"> <li>• The specified total number of digits is out of the range, 2 to 13.</li> <li>• The specified number of digits in the decimal part of (s1)+1 is out of the range, 0 to 10.</li> <li>• When the specified number of digits in the decimal part of (s1)+1 is in the range 0 to 10, the relationship between the total number of digits specified by (s1) and the number of digits in the decimal part specified by (s1)+1 does not satisfy the following.<br/>(Total number of digits)-3 ≥ Number of digits in the decimal part</li> <li>• The number of digits specified by (s1) is smaller than the number of digits plus 2 of the 32-bit binary data specified by (s2).<br/>[Number of digits in (s1)] &lt; [Number of digits of 32-bit binary data excluding the sign in (s2) + Number of digits in the sign (+ or -) + Number of digits of decimal point (.)]</li> </ul> |
| 3286H            | <p>The entire string that was converted in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

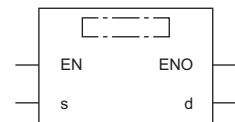
# Converting BCD 4-digit data to decimal ASCII code

## BCDDA(P)

These instructions convert BCD 4-digit data to the ASCII code.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | <pre>ENO:=BCDDA(EN,s,d); ENO:=BCDDAP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BCDDA       |                     |
| BCDDAP      |                     |

## Setting data

## Description, range, data type

| Operand | Description                                    | Range     | Data type   | Data type (label) |
|---------|------------------------------------------------|-----------|-------------|-------------------|
| (s)     | BCD data used for ASCII conversion             | 0 to 9999 | BCD 4-digit | ANY16             |
| (d)     | Start device for storing the conversion result | —         | String      | ANYSTRING_SINGLE  |
| EN      | Execution condition                            | —         | Bit         | BOOL              |
| ENO     | Execution result                               | —         | Bit         | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the numerical value of each digit of the BCD 4-digit data in the device specified by (s) to the ASCII code, and store the converted data in the device number specified by (d) and later.
- The format of the hexadecimal ASCII data to be stored in (d) depends on the status of SM705 (Number of conversion digits selection).

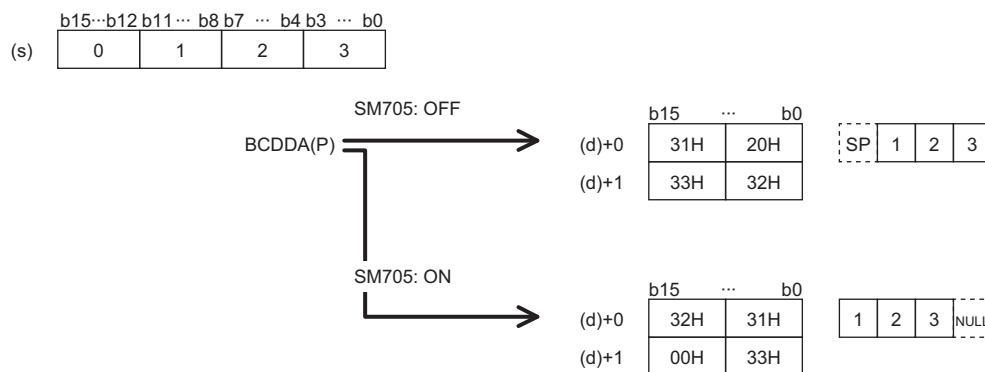
| Status of SM705 | Storage format of (d)                                              | Reference                                                                       |
|-----------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Off             | Data is stored in a fixed number of digits (4 digits)              | Page 758 Operation of when SM705 (Number of conversion digits selection) is off |
| On              | Each digit is stored left-justified depending on the value of (s). | Page 758 Operation of when SM705 (Number of conversion digits selection) is on  |

### ■ Operation overview

The following figure shows the operation when SM705 (Number of conversion digits selection) is off and on.

**Ex.**

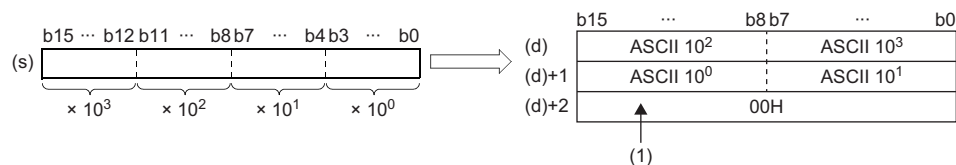
When the BCDDA(P) instruction is executed with BCD 4-digit data "0123" stored in (s)



- When SM705 is off, the number of digits is fixed. The leading "0" of "0123" is converted into 20H (space) and stored.
- When SM705 is on, data is left-justified. "0123" with the leading "0" omitted ("123") is converted into ASCII data and stored, and 00H is stored in the end.

## ■Operation of when SM705 (Number of conversion digits selection) is off

Decimal ASCII data is stored in a fixed number of digits (4 digits) in (d) to (d)+1.



ASCII 10<sup>3</sup>: Thousands place of ASCII code

ASCII 10<sup>2</sup>: Hundreds place of ASCII code

ASCII 10<sup>1</sup>: Tens place of ASCII code

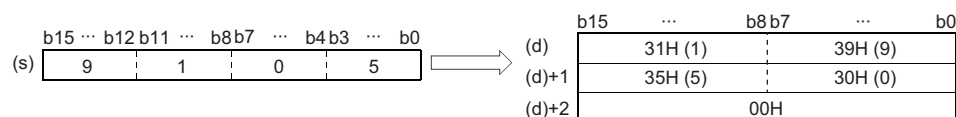
ASCII 10<sup>0</sup>: Ones place of ASCII code

(1) 00H is stored in (d)+2 when SM701 (Number of output characters selection) is off. When it is on, the value remains unchanged.

- 20H (space) is stored for the leading "0"s at the left of the effective number of digits of the operation result stored in the device specified by (d). (Zero-suppression) For "0050", "00" becomes 20H (space) and "50" is the effective number of digits.

### Ex.

When 9105 is specified in (s)



## ■Operation of when SM705 (Number of conversion digits selection) is on

Decimal ASCII data for the number of digits (up to 4 digits) without the leftmost "0" in the effective digits is stored in (d).

The following figures show an example of a value of (s) and a value stored in (d).

| Value of (s) | Data of (d) to (d)+1                                                                                                                                                                                                                         | Value of (s)   | Data of (d) to (d)+1                                                                                                                                                                                                                                                                                                                 |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0H to 9H     | <ul style="list-style-type: none"> <li>The upper byte of (d) is filled with 00H.</li> <li>(d)+1 and later remain unchanged.</li> </ul> <div> <div>b15 ... b8 b7 ... b0</div> <div>(d) 00H ASCII 10<sup>0</sup></div> <div>(d)+1</div> </div> | 10H to 99H     | (d)+1 is filled with 00H. <div> <div>b15 ... b8 b7 ... b0</div> <div>(d) ASCII 10<sup>0</sup> ASCII 10<sup>1</sup></div> <div>(d)+1 00H</div> </div>                                                                                                                                                                                 |
| 100H to 999H | The upper byte of (d)+1 are filled with 00H. <div> <div>b15 ... b8 b7 ... b0</div> <div>(d) ASCII 10<sup>1</sup> ASCII 10<sup>2</sup></div> <div>(d)+1 00H ASCII 10<sup>0</sup></div> </div>                                                 | 1000H to 9999H | (1) (d)+2 is filled with 00H when SM701 (Number of output characters selection) is off. (d)+2 remains unchanged if SM701 is on. <div> <div>b15 ... b8 b7 ... b0</div> <div>(d) ASCII 10<sup>2</sup> ASCII 10<sup>3</sup></div> <div>(d)+1 ASCII 10<sup>0</sup> ASCII 10<sup>1</sup></div> <div>(d)+2 00H</div> <div>(1)</div> </div> |

ASCII 10<sup>3</sup>: Thousands place of ASCII code

ASCII 10<sup>2</sup>: Hundreds place of ASCII code

ASCII 10<sup>1</sup>: Tens place of ASCII code

ASCII 10<sup>0</sup>: Ones place of ASCII code

- When the number of digits is less than the maximum number of digits (4 digits), 00H is stored in the end of the string regardless of the status (on/off) of SM701 (Number of output characters selection). If the end of the string is the lower byte, 00H is also stored in the upper byte.
- When the number of digits is equal to the maximum number of digits (4 digits), 00H is stored in (d)+2 when SM701 is off. (d)+2 remains unchanged if SM701 is on.



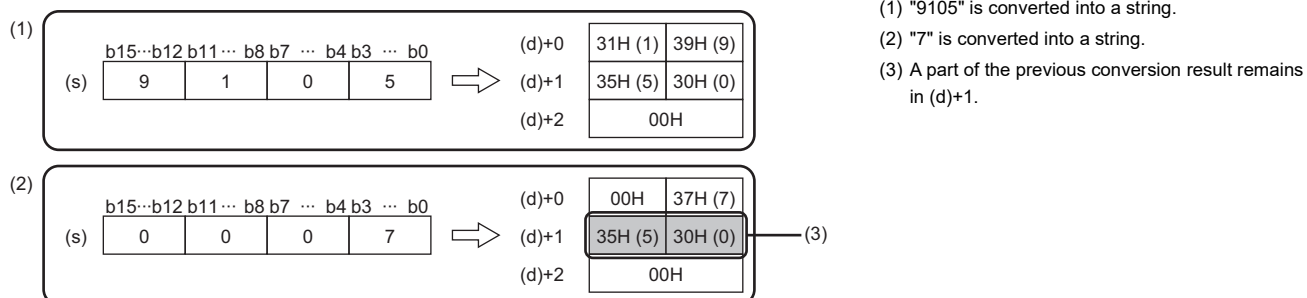
## Operation error

| Error code (SD0) | Description                                                                                                                                                  |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | Data in the device specified by (s) is out of the range, 0 to 9999.                                                                                          |
| 3286H            | The entire string that was converted in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored. |

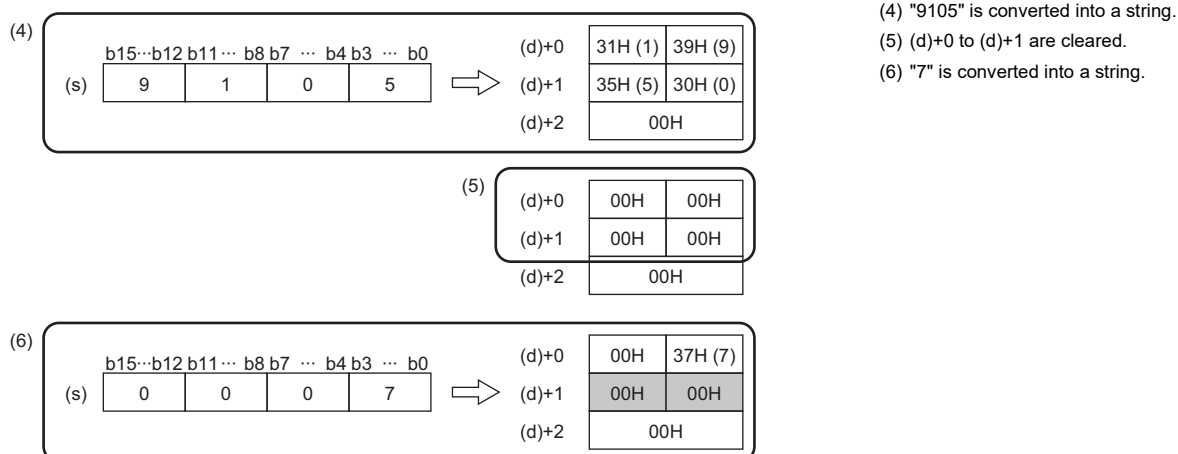
## Precautions

When SM705 (Number of conversion digits selection) is on, the operation result is stored in (d) for the effective number of digits. Therefore, when the BCDDA(P) instruction is executed successively and the operation result for each execution is stored in the same device, a part of the previous operation result may not be overwritten by the succeeding result and can remain in (d).

[Example] Executing the BCDDA(P) instruction when (s) is "9105H" and then executing another BCDDA(P) instruction when (s) is "0007H"



To avoid this, create a program to clear the entire data storage areas (d)+0 and (d)+1 before executing the BCDDA(P) instruction.



# Converting BCD 8-digit data to decimal ASCII code

## DBCDDA(P)

These instructions convert BCD 8-digit data to the ASCII code.

| Ladder | ST                                            |
|--------|-----------------------------------------------|
|        | ENO:=DBCDDA(EN,s,d);<br>ENO:=DBCDDAP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DBCDDA      |                     |
| DBCDDAP     |                     |

### Setting data

### Description, range, data type

| Operand | Description                                    | Range         | Data type   | Data type (label) |
|---------|------------------------------------------------|---------------|-------------|-------------------|
| (s)     | BCD data used for ASCII conversion             | 0 to 99999999 | BCD 8-digit | ANY32             |
| (d)     | Start device for storing the conversion result | —             | String      | ANYSTRING_SINGLE  |
| EN      | Execution condition                            | —             | Bit         | BOOL              |
| ENO     | Execution result                               | —             | Bit         | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the numerical value of each digit of the BCD 8-digit data in the device specified by (s) to the ASCII code, and store the converted data in the device number specified by (d) and later.
- The format of the decimal ASCII data to be stored in (d) depends on the status of SM705 (Number of conversion digits selection).

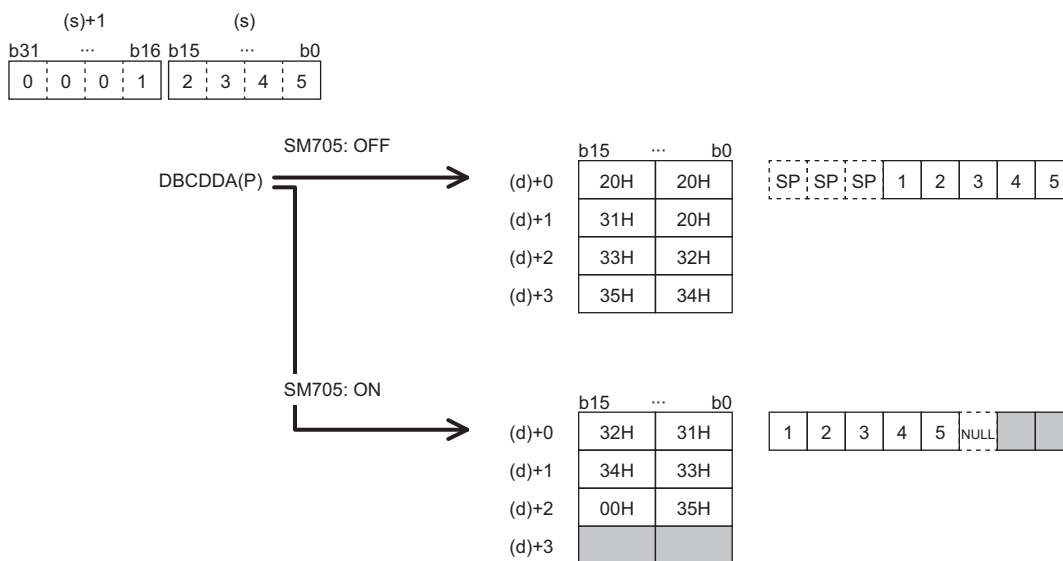
| Status of SM705 | Storage format of (d)                                              | Reference                                                                       |
|-----------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Off             | Data is stored in a fixed number of digits (8 digits)              | Page 762 Operation of when SM705 (Number of conversion digits selection) is off |
| On              | Each digit is stored left-justified depending on the value of (s). | Page 763 Operation of when SM705 (Number of conversion digits selection) is on  |

### ■ Operation overview

The following figure shows the operation when SM705 (Number of conversion digits selection) is off and on.

**Ex.**

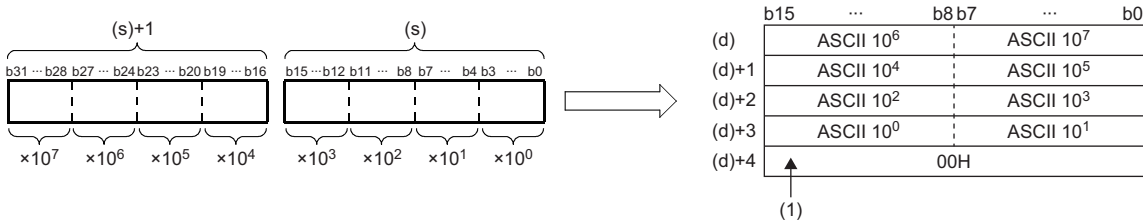
When the DBCDDA(P) instruction is executed with BCD 8-digit data "00012345" stored in (s)



- When SM705 is off, the number of digits is fixed. Each of the leading "0"s of "00012345" is converted into 20H (space) and stored.
- When SM705 is on, data is left-justified. "00012345" with the leading "0"s omitted ("12345") is converted into ASCII data and stored, and 00H is stored in the end.

■Operation of when SM705 (Number of conversion digits selection) is off

Decimal ASCII data is stored in a fixed number of digits (8 digits) in (d) to (d)+3.



ASCII 10<sup>7</sup>: Ten-millions place of ASCII code

ASCII 10<sup>6</sup>: Millions place of ASCII code

⋮

ASCII 10<sup>1</sup>: Tens place of ASCII code

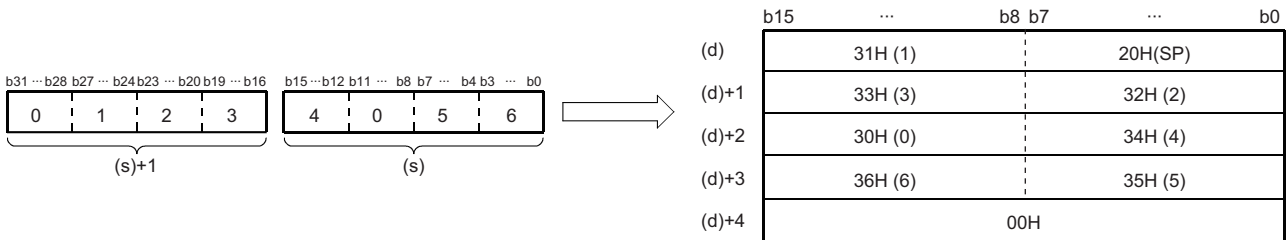
ASCII 10<sup>0</sup>: Ones place of ASCII code

(1) 00H is stored in (d)+4 when SM701 (Number of output characters selection) is off. When it is on, the value remains unchanged.

- 20H (space) is stored for the leading "0"s at the left of the effective number of digits of the operation result stored in the device specified by (d). (Zero-suppression) For "00012098", "000" becomes 20H (space) and "12098" is the effective number of digits.

Ex.

When 01234056 is specified in (s)



## ■Operation of when SM705 (Number of conversion digits selection) is on

Decimal ASCII data for the number of digits (up to 8 digits) without the leftmost "0" in the effective digits is stored in (d).

The following figures show an example of a value of (s) and a value stored in (d).

| Value of (s)         | Data of (d) to (d)+3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Value of (s) | Data of (d) to (d)+3 |                       |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------|-----------------------|-----|----|-----|----|-----|-----------------------|--|--|-----------------------|--|--|-------|-----------------------|--|--|-----------------------|--|--|-------|-----------------------|--|--|-----------------------|--|--|-------|-----|--|--|-----------------------|--|--|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----|-----|----|----|-----|----|-----|-----------------------|--|--|-----------------------|--|--|-------|-----------------------|--|--|-----------------------|--|--|-------|-----------------------|--|--|-----------------------|--|--|-------|-----------------------|--|--|-----------------------|--|--|-------|-----|--|--|--|--|--|
| 0H to 9H             | <div><ul style="list-style-type: none"><li>The upper byte of (d) is filled with 00H.</li><li>(d)+1 and later remain unchanged.</li></ul></div> <div><table><tr><td></td><td>b15</td><td>...</td><td>b8</td><td>b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td colspan="3">00H</td><td colspan="3">ASCII 10<sup>0</sup></td></tr><tr><td>(d)+1</td><td colspan="6"></td></tr><tr><td>(d)+2</td><td colspan="6"></td></tr><tr><td>(d)+3</td><td colspan="6"></td></tr></table></div>                                                                                                |              | b15                  | ...                   | b8  | b7 | ... | b0 | (d) | 00H                   |  |  | ASCII 10 <sup>0</sup> |  |  | (d)+1 |                       |  |  |                       |  |  | (d)+2 |                       |  |  |                       |  |  | (d)+3 |     |  |  |                       |  |  | 10H to 99H             | <div><ul style="list-style-type: none"><li>(d)+1 is filled with 00H.</li><li>(d)+2 and later remain unchanged.</li></ul></div> <div><table><tr><td></td><td>b15</td><td>...</td><td>b8</td><td>b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td colspan="3">ASCII 10<sup>0</sup></td><td colspan="3">ASCII 10<sup>1</sup></td></tr><tr><td>(d)+1</td><td colspan="6">00H</td></tr><tr><td>(d)+2</td><td colspan="6"></td></tr><tr><td>(d)+3</td><td colspan="6"></td></tr></table></div>                                                                                                                                                                                                                                                                                                                |  | b15 | ... | b8 | b7 | ... | b0 | (d) | ASCII 10 <sup>0</sup> |  |  | ASCII 10 <sup>1</sup> |  |  | (d)+1 | 00H                   |  |  |                       |  |  | (d)+2 |                       |  |  |                       |  |  | (d)+3 |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
|                      | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ...          | b8                   | b7                    | ... | b0 |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)                  | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |                      | ASCII 10 <sup>0</sup> |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+1                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                      |                       |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+2                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                      |                       |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+3                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                      |                       |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
|                      | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ...          | b8                   | b7                    | ... | b0 |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)                  | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                      | ASCII 10 <sup>1</sup> |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+1                | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |                      |                       |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+2                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                      |                       |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+3                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                      |                       |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| ⋮                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                      |                       |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| 1000000H to 9999999H | <div>The upper byte of (d)+3 is filled with 00H.</div> <div><table><tr><td></td><td>b15</td><td>...</td><td>b8</td><td>b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td colspan="3">ASCII 10<sup>5</sup></td><td colspan="3">ASCII 10<sup>6</sup></td></tr><tr><td>(d)+1</td><td colspan="3">ASCII 10<sup>3</sup></td><td colspan="3">ASCII 10<sup>4</sup></td></tr><tr><td>(d)+2</td><td colspan="3">ASCII 10<sup>1</sup></td><td colspan="3">ASCII 10<sup>2</sup></td></tr><tr><td>(d)+3</td><td colspan="3">00H</td><td colspan="3">ASCII 10<sup>0</sup></td></tr></table></div> |              | b15                  | ...                   | b8  | b7 | ... | b0 | (d) | ASCII 10 <sup>5</sup> |  |  | ASCII 10 <sup>6</sup> |  |  | (d)+1 | ASCII 10 <sup>3</sup> |  |  | ASCII 10 <sup>4</sup> |  |  | (d)+2 | ASCII 10 <sup>1</sup> |  |  | ASCII 10 <sup>2</sup> |  |  | (d)+3 | 00H |  |  | ASCII 10 <sup>0</sup> |  |  | 10000000H to 99999999H | <div>(1) (d)+4 is filled with 00H when SM701 (Number of output characters selection) is off. (d)+4 does not change if SM701 (Number of output characters selection) is on.</div> <div><table><tr><td></td><td>b15</td><td>...</td><td>b8</td><td>b7</td><td>...</td><td>b0</td></tr><tr><td>(d)</td><td colspan="3">ASCII 10<sup>6</sup></td><td colspan="3">ASCII 10<sup>7</sup></td></tr><tr><td>(d)+1</td><td colspan="3">ASCII 10<sup>4</sup></td><td colspan="3">ASCII 10<sup>5</sup></td></tr><tr><td>(d)+2</td><td colspan="3">ASCII 10<sup>2</sup></td><td colspan="3">ASCII 10<sup>3</sup></td></tr><tr><td>(d)+3</td><td colspan="3">ASCII 10<sup>0</sup></td><td colspan="3">ASCII 10<sup>1</sup></td></tr><tr><td>(d)+4</td><td colspan="6">00H</td></tr></table><div><div>↑</div>(1)</div></div> |  | b15 | ... | b8 | b7 | ... | b0 | (d) | ASCII 10 <sup>6</sup> |  |  | ASCII 10 <sup>7</sup> |  |  | (d)+1 | ASCII 10 <sup>4</sup> |  |  | ASCII 10 <sup>5</sup> |  |  | (d)+2 | ASCII 10 <sup>2</sup> |  |  | ASCII 10 <sup>3</sup> |  |  | (d)+3 | ASCII 10 <sup>0</sup> |  |  | ASCII 10 <sup>1</sup> |  |  | (d)+4 | 00H |  |  |  |  |  |
|                      | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ...          | b8                   | b7                    | ... | b0 |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)                  | ASCII 10 <sup>5</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                      | ASCII 10 <sup>6</sup> |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+1                | ASCII 10 <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                      | ASCII 10 <sup>4</sup> |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+2                | ASCII 10 <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                      | ASCII 10 <sup>2</sup> |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+3                | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |                      | ASCII 10 <sup>0</sup> |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
|                      | b15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ...          | b8                   | b7                    | ... | b0 |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)                  | ASCII 10 <sup>6</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                      | ASCII 10 <sup>7</sup> |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+1                | ASCII 10 <sup>4</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                      | ASCII 10 <sup>5</sup> |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+2                | ASCII 10 <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                      | ASCII 10 <sup>3</sup> |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+3                | ASCII 10 <sup>0</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                      | ASCII 10 <sup>1</sup> |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |
| (d)+4                | 00H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |                      |                       |     |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |                       |  |  |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |     |    |    |     |    |     |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |                       |  |  |                       |  |  |       |     |  |  |  |  |  |

ASCII 10<sup>7</sup>: Ten-millions place of ASCII code

ASCII 10<sup>6</sup>: Millions place of ASCII code

⋮

ASCII 10<sup>1</sup>: Tens place of ASCII code

ASCII 10<sup>0</sup>: Ones place of ASCII code

- When the number of digits is less than the maximum number of digits (8 digits), 00H is stored in the end of the string regardless of the status (on/off) of SM701 (Number of output characters selection). If the end of the string is the lower byte, 00H is also stored in the upper byte.
- When the number of digits is equal to the maximum number of digits (8 digits), 00H is stored in (d)+4 when SM701 (Number of output characters selection) is off. (d)+4 does not change if SM701 (Number of output characters selection) is on.

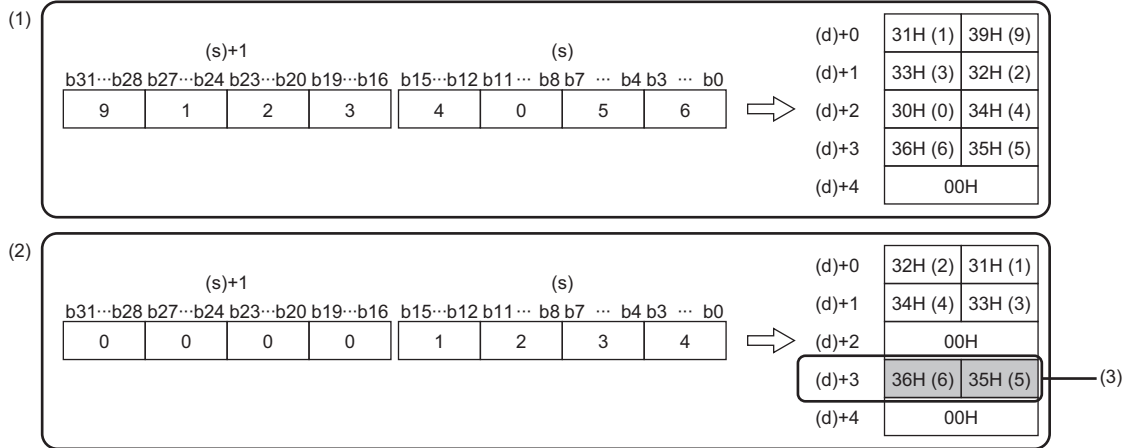
## Operation error

| Error code (SD0) | Description                                                                                                                                                  |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | Data in the device specified by (s) is out of the range, 0 to 99999999.                                                                                      |
| 3286H            | The entire string that was converted in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored. |

## Precautions

When SM705 (Number of conversion digits selection) is on, the operation result is stored in (d) for the effective number of digits. Therefore, when the DBCDDA(P) instruction is executed successively and the operation result for each execution is stored in the same device, a part of the previous operation result may not be overwritten by the succeeding result and can remain in (d).

[Example] Executing the DBCDDA(P) instruction when (s) is "91234056H" and then executing another DBCDDA(P) instruction when (s) is "00001234H"

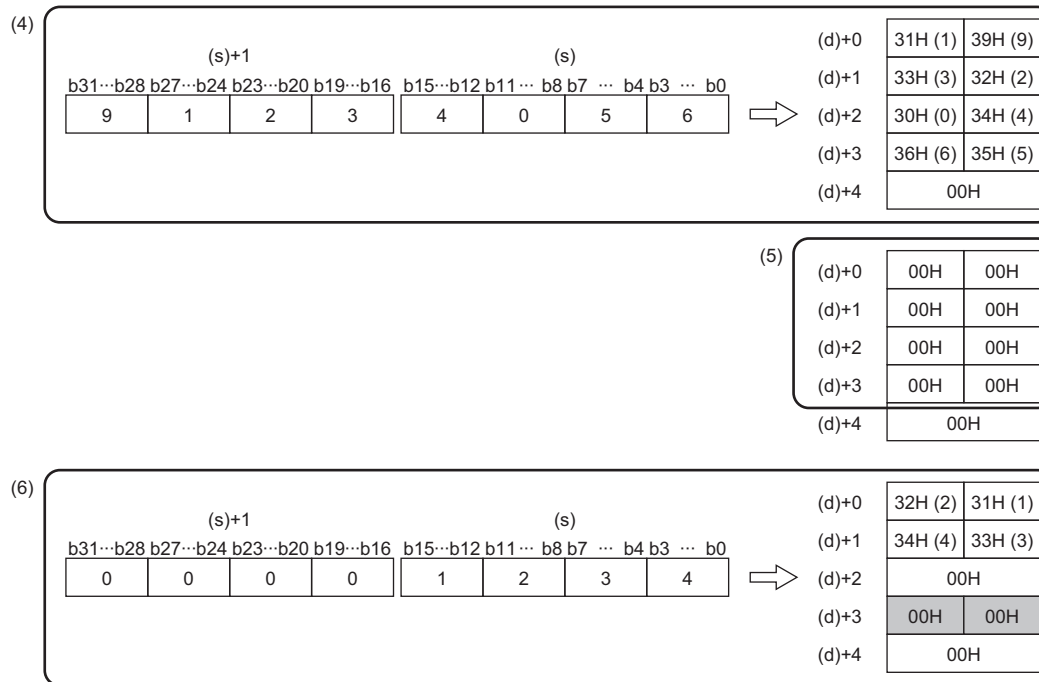


(1) "91234056" is converted into a string.

(2) "1234" is converted into a string.

(3) A part of the previous conversion result remains in (d)+3.

To avoid this, create a program to clear the entire data storage areas (d)+0 to (d)+3 before executing the DBCDDA(P) instruction.



(4) "91234056" is converted into a string.

(5) (d)+0 to (d)+3 are cleared.

(6) "1234" is converted into a string.

# Converting single-precision real number to string data

## ESTR(P)

These instructions convert single-precision real number data to a string according to the display specification.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=ESTR(EN,s1,s2,d); ENO:=ESTRP(EN,s1,s2,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ESTR        |                     |
| ESTRP       |                     |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                                                                | Range                            | Data type                    | Data type (label)                      |
|---------|--------------------------------------------------------------------------------------------|----------------------------------|------------------------------|----------------------------------------|
| (s1)    | Single-precision real number data to be converted, or the start device containing the data | $0, 2^{-126} <  (s1)  < 2^{128}$ | Single-precision real number | ANYREAL_32                             |
| (s2)    | Start device containing the display specification of the real number to be converted       | —                                | 16-bit signed binary         | ANY16_ARRAY<br>(Number of elements: 3) |
| (d)     | Start device for storing the converted string                                              | —                                | String                       | ANYSTRING_SINGLE                       |
| EN      | Execution condition                                                                        | —                                | Bit                          | BOOL                                   |
| ENO     | Execution result                                                                           | —                                | Bit                          | BOOL                                   |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

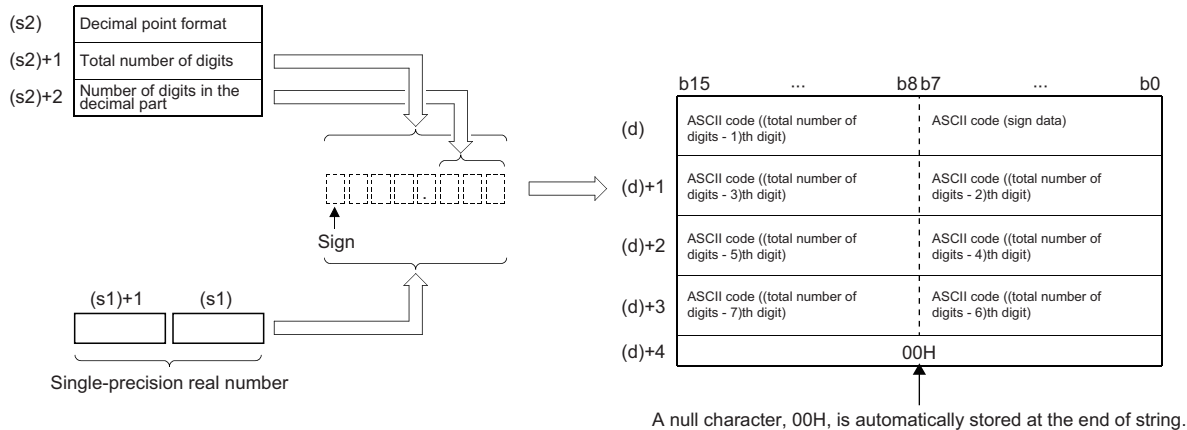
## Processing details

- These instructions convert the single-precision real number data stored in the device specified by (s1) to a string according to the display specification stored in the device number specified by (s2) and later, and store the converted data in the device number specified by (d) and later.
- The type of the converted data varies depending on the display specification stored in the device specified by (s2).

|        |                                               |
|--------|-----------------------------------------------|
| (s2)   | 0: Decimal point format<br>1: Exponent format |
| (s2)+1 | Total number of digits                        |
| (s2)+2 | Number of digits in the decimal part          |

### ■Decimal point format

- When 0 is specified in (s2), the decimal point format is used.



- When storing the decimal part in (d), the total number of digits that can be specified by (s2) + 1 is the total number of digits (maximum of 24)  $\geq$  (number of digits in the integral part<sup>\*1</sup> + number of digits in the decimal part + 2). The number of digits in the decimal part that can be specified by (s2)+2 is 0 to 7. Note that the number of digits in the decimal part must be equal to or smaller than the total number of digits minus 3.

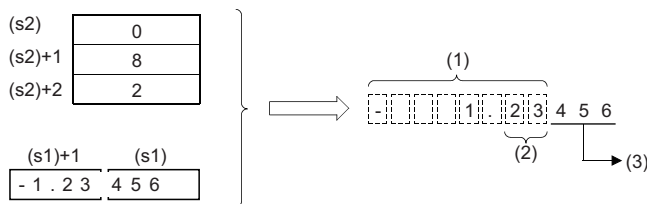
\*1 Indicates the number of digits in the integral part of the 32-bit floating point real number data in the device specified by (s1).

- When not storing the decimal part in (d), the total number of digits that can be specified by (s2) + 1 is the total number of digits (maximum of 24)  $\geq$  (number of digits in the integral part<sup>\*2</sup> + 1). The number of digits in the decimal part that can be specified by (s2)+2 cannot be set.

\*2 Indicates the number of digits in the integral part of the 32-bit floating point real number data in the device specified by (s1).

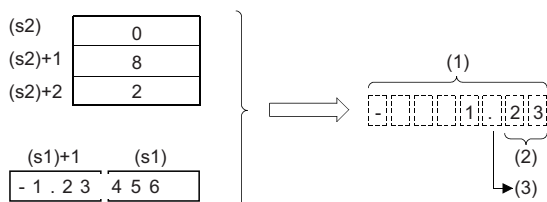
- The converted string data are stored in the device areas specified by (d) and later as shown below.

- As sign data, 20H (space) is stored if the single-precision real number data is positive, and 2DH (-) is stored if the data is negative.
- If the decimal part of the single-precision real number data is not stored within the range of the number of digits in the decimal part, the lower decimal digits are rounded off.



- (1) Total number of digits
- (2) Number of digits in the decimal part
- (3) Rounded off.

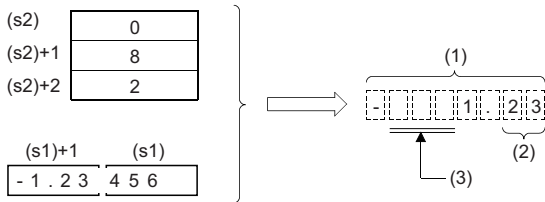
- If the number of digits in the decimal part is set to a value other than 0, 2EH (.) is automatically stored at the position of the specified number of digits in the decimal part plus 1. If the number of digits in the decimal part is 0, "2EH" (.) is not stored.





- (1) Total number of digits
- (2) Number of digits in the decimal part
- (3) Automatically added.

- If the number of digits excluding the sign, decimal point, and decimal part from the total number of digits is greater than the number of digits in the integral part of single-precision real number data, 20H (space) is stored between the sign and integral part.

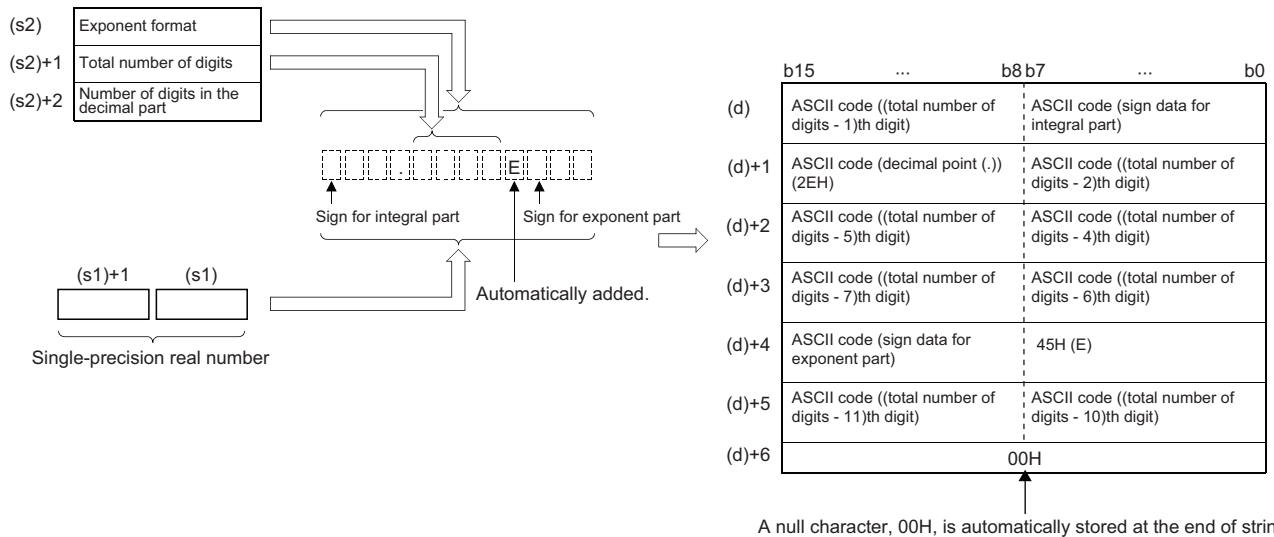


- (1) Total number of digits
- (2) Number of digits in the decimal part
- (3) Filled with 20H (space).

- The value "00H" is automatically stored at the end of the converted string.
- The number of digits in the integral part of the 32-bit floating point real number data in the device specified by (s1) can be 1 to 16.

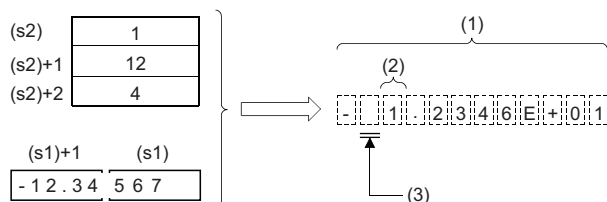
## ■Exponential format

- When 1 is specified in (s2), the exponential format is used.



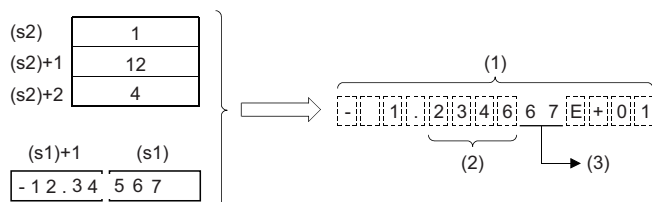
- When storing the decimal part in (d), the total number of digits that can be specified by (s2) + 1 is the number of digits (maximum of 24)  $\geq$  (number of digits in the decimal part+7). The number of digits in the decimal part that can be specified by (s2)+2 is 0 to 7. Note that the number of digits in the decimal part must be equal to or smaller than the total number of digits minus 7.
- When not storing the decimal part in (d), the total number of digits that can be specified by (s2) + 1 is the number of digits (maximum of 24)  $\geq$  6. The number of digits in the decimal part that can be specified by (s2)+2 cannot be set.

- The converted string data are stored in the device areas specified by (d) and later as shown below.
- As sign data in the integral part, 20H (space) is stored if the single-precision real number data is positive, and 2DH (-) is stored if the data is negative.
- The integral part is fixed to one digit. 20H (space) is stored between the integral part and sign.



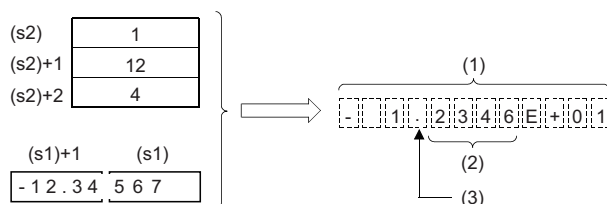
- (1) Total number of digits
- (2) Fixed to 1 digit
- (3) Filled with 20H (space).

- If the decimal part of the single-precision real number data is not stored within the range of the number of digits in the decimal part, the lower decimal digits are rounded off.



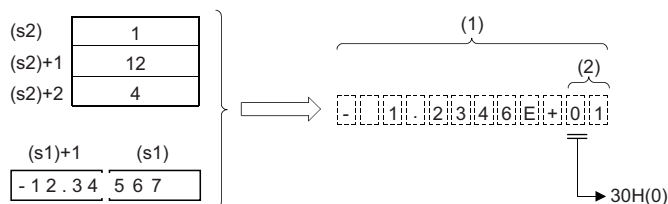
- (1) Total number of digits
- (2) Number of digits in the decimal part
- (3) Rounded down.

- If the number of digits in the decimal part is set to a value other than 0, 2EH (.) is automatically stored at the position of the specified number of digits in the decimal part plus 1. If the number of digits in the decimal part is 0, "2EH" (.) is not stored.



- (1) Total number of digits
- (2) Number of digits in the decimal part
- (3) Automatically added.

- As sign data in the exponent part, 2BH (+) is stored if the exponent is positive, and 2DH (-) is stored if it is negative.
- The exponent part is fixed to two digits. When the exponent part is one digit, 30H(0) is stored between the exponent part and sign.



- (1) Total number of digits
- (2) Fixed to 2 digits

- The value "00H" is automatically stored at the end of the converted string.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | <p>The value in the device specified by (s1) is not in the following range.<br/> <math>0, 2^{-126} \leq  (s1)  &lt; 2^{128}</math></p> <hr/> <p>Invalid data that cannot be converted is set to (s2).</p> <ul style="list-style-type: none"> <li>The format specification in the device specified by (s2) is a value other than 0 and 1.</li> <li>In the decimal point format, the total number of digits specified by (s2)+1 is outside the following range.</li> </ul> <p>The number of digits in the decimal part is 0: Total number of digits <math>\geq</math> number of digits in the integral part<sup>*1</sup>+1<br/> The number of digits in the decimal part is not 0: Total number of digits <math>\geq</math> number of digits in the integral part<sup>*1</sup>+ number of digits in the decimal point+2</p> <ul style="list-style-type: none"> <li>In the decimal point format, the total number of digits specified by (s2)+1 and the number of digits in the decimal part specified by (s2)+2 are outside the following range.</li> </ul> <p>The number of digits in the decimal part is 0: Total number of digits <math>\geq 2</math><br/> The number of digits in the decimal part is not 0: Total number of digits <math>\geq</math> (number of digits in the decimal point+3)</p> <ul style="list-style-type: none"> <li>In the exponential format, the total number of digits specified by (s2)+1 is outside the following range.</li> </ul> <p>The number of digits in the decimal part is 0: Total number of digits <math>\geq 6</math><br/> The number of digits in the decimal part is not 0: Total number of digits <math>\geq</math> (number of digits in the decimal part+7)</p> <ul style="list-style-type: none"> <li>In the exponential point format, the decimal part digit specification in the device specified by (s2)+2 is outside the following range.</li> </ul> <p>Decimal point format: Number of digits in the decimal part <math>\leq</math> (total number of digits - 3)<br/> Exponential format: Number of digits in the decimal part <math>\leq</math> (Total number of digits - 7)</p> <ul style="list-style-type: none"> <li>In the decimal point format, the number of digits in the integral part of 32-bit floating point real number data in the device specified by (s1) exceeds 16.</li> <li>The number of digits in the decimal part specified by (s2)+2 is out of the range from 0 to 7.</li> </ul> <hr/> <p>The specified value consists of more than 24 digits in total.</p> <hr/> |
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 3286H            | The entire string that was converted in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

\*1 Indicates the number of digits in the integral part of the 32-bit floating point real number data in the device specified by (s1).

# Converting hexadecimal binary data to hexadecimal ASCII code

## INT2ASC(P)

These instructions convert 16-bit binary data to the hexadecimal ASCII code and store it in any specified range.

| Ladder | ST                                                         |
|--------|------------------------------------------------------------|
|        | <pre>ENO:=INT2ASC(EN,s,n,d); ENO:=INT2ASCP(EN,s,n,d)</pre> |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| INT2ASC     |                     |
| INT2ASCP    |                     |

## Setting data

## Descriptions, ranges, and data types

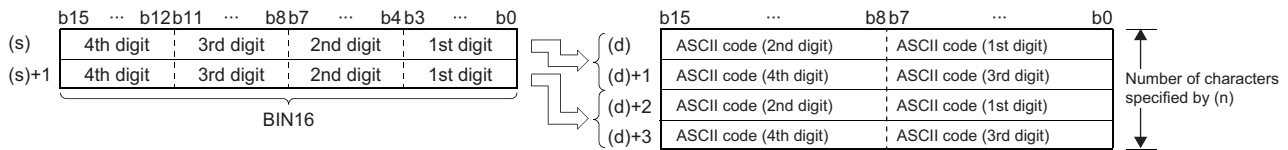
| Operand | Description                                                         | Range      | Data type            | Data type (label)   |
|---------|---------------------------------------------------------------------|------------|----------------------|---------------------|
| (s)     | Start device containing the binary data to be exchanged to a string | —          | 16-bit signed binary | ANY16 <sup>*1</sup> |
| (d)     | Start device for storing the converted string                       | —          | String               | ANYSTRING_SINGLE    |
| (n)     | Number of characters to be stored                                   | 0 to 16383 | 16-bit signed binary | ANY16               |
| EN      | Execution condition                                                 | —          | Bit                  | BOOL                |
| ENO     | Execution result                                                    | —          | Bit                  | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

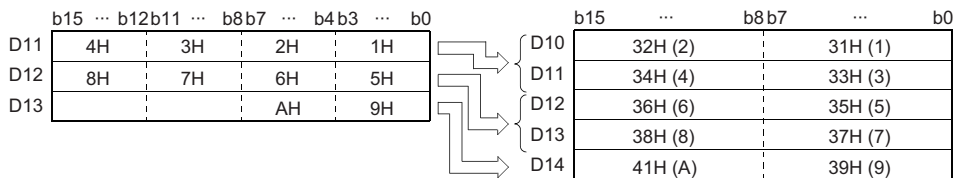
## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

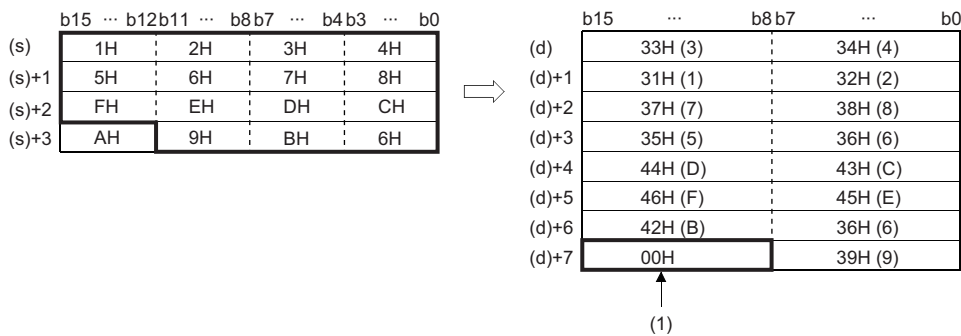
- Converts the 16-bit binary data in the device number specified by (s) and later to hexadecimal ASCII, and stores the converted data by the number of characters in the device specified by (n) in the device number specified by (d) and later.



- Setting the number of bytes by (n) automatically determines the range of binary data in the device specified by (s) and the range of the device specified by (d) for storing the string data.
- Processing is performed normally even if the device range in which the binary data to be converted and the device range for storing the converted binary data are overlapping.



- If the number of characters in the device specified by (n) is an odd number, 00H is automatically stored in the upper 8 bits of the last device number among device numbers for storing the converted string data.



(1) 00H is automatically stored.

- If the number of characters in the device specified by (n) is 0, no processing is performed.

## Operation error

| Error code (SD0) | Description                                                                                                                                           |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | An out-of-range value is set to (n). <ul style="list-style-type: none"> <li>The specified number of characters is not between 0 and 16383.</li> </ul> |

# Converting and concatenating multiple data strings

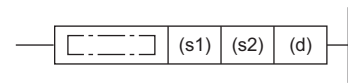
## SPF(P)

Multiple data is converted to a string according to the specified display format, the string is concatenated with any string, and they are output as a single string.

### Restriction

Before using the instruction, check the versions of the controller and engineering tool.

 User's manual for the controller used

| Ladder                                                                            | ST                                              |
|-----------------------------------------------------------------------------------|-------------------------------------------------|
|  | ENO:=SPF(EN,s1,s2,d);<br>ENO:=SPFP(EN,s1,s2,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                                 |
|-------------|-------------------------------------------------------------------------------------|
| SPF         |  |
| SPFP        |  |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                         | Range | Data type            | Data type (label) |
|---------|---------------------------------------------------------------------|-------|----------------------|-------------------|
| (s1)    | String data and display format, or the start device containing them | —     | String               | ANYSTRING_SINGLE  |
| (s2)    | Start device where the conversion target data is stored             | —     | 16-bit signed binary | ANY16             |
| (d)     | Start device for storing the converted and concatenated string      | —     | String               | ANYSTRING_SINGLE  |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- This instruction converts data stored in the device number specified by (s2) and later into strings according to the display format specified by (s1). Then, the strings are concatenated with a given string stored in (s1), and they are stored as a single string in the device number specified by (d) and later. The given string can be omitted, allowing only the data stored in the device number specified by (s2) and later to be concatenated.
- The display format is as follows: Specifiers are combined in the order starting from "%", followed by [Flag], [Minimum field width], [Accuracy], [Acquisition data size], and [Conversion specifier]. The specifiers are stored together with the concatenation target string in (s1). The following table lists the display format selection items that can be used. If the order of the display format items is incorrect, an error occurs.

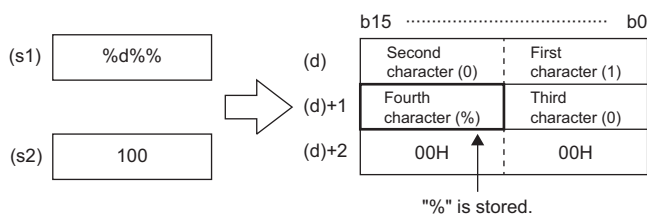
| Display format        | Specifier <sup>*1</sup>            | Description                                                                                                                                                                                                                                                      | Details                        |
|-----------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Flag                  | -, +, " " (space), #, and 0        | Modifies the string to be output to (d) according to the specified specifier.                                                                                                                                                                                    | Page 775 Flag                  |
| Minimum field width   | Any numerical value                | Specifies the total number of characters to be output to (d), including the sign of the converted string, decimal point, exponent part, and " " (space). When this item is omitted, the number of characters for the retrieved data is specified for the output. | Page 776 Minimum field width   |
| Accuracy              | "." (period) numerical value       | Specifies the number of characters to be output to (d) with [Conversion specifier] from the data stored in (s2).                                                                                                                                                 | Page 777 Accuracy              |
| Acquisition data size | w, q                               | Specifies how many words of the data stored in (s2) are to be converted and output to (d). When this item is omitted, the data is retrieved in units of one word.                                                                                                | Page 779 Acquisition data size |
| Conversion specifier  | d, u, x, X, o, s, c, f, e, E, g, G | Specifies the output format of the string to be output to (d).                                                                                                                                                                                                   | Page 780 Conversion specifier  |

<sup>\*1</sup> Specifiers are case-sensitive.

- [Flag], [Minimum field width], [Accuracy], and [Acquisition data size] can be omitted.
- Only if "%" is output as a character, [Conversion specifier] can be omitted. When "%" is stored in (s1) and output as a string, "%" will be stored in (d) as a string. The data stored following "%" is output as a character up to the next display format.

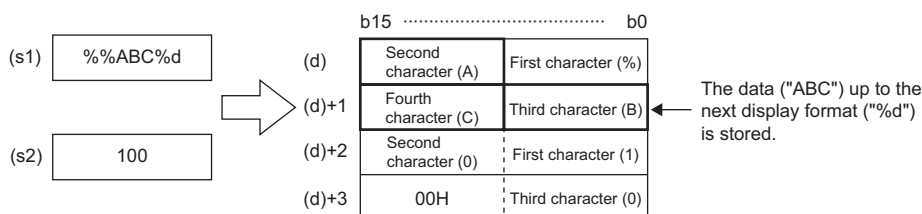
### Ex.

When "%d%" is stored in (s1) and "100" is stored in the device specified by (s2), "100%" is stored in the device specified by (d).



### Ex.

When "%ABC%d" is stored in (s1) and "100" is stored in the device specified by (s2), "%ABC100" is stored in the device specified by (d).

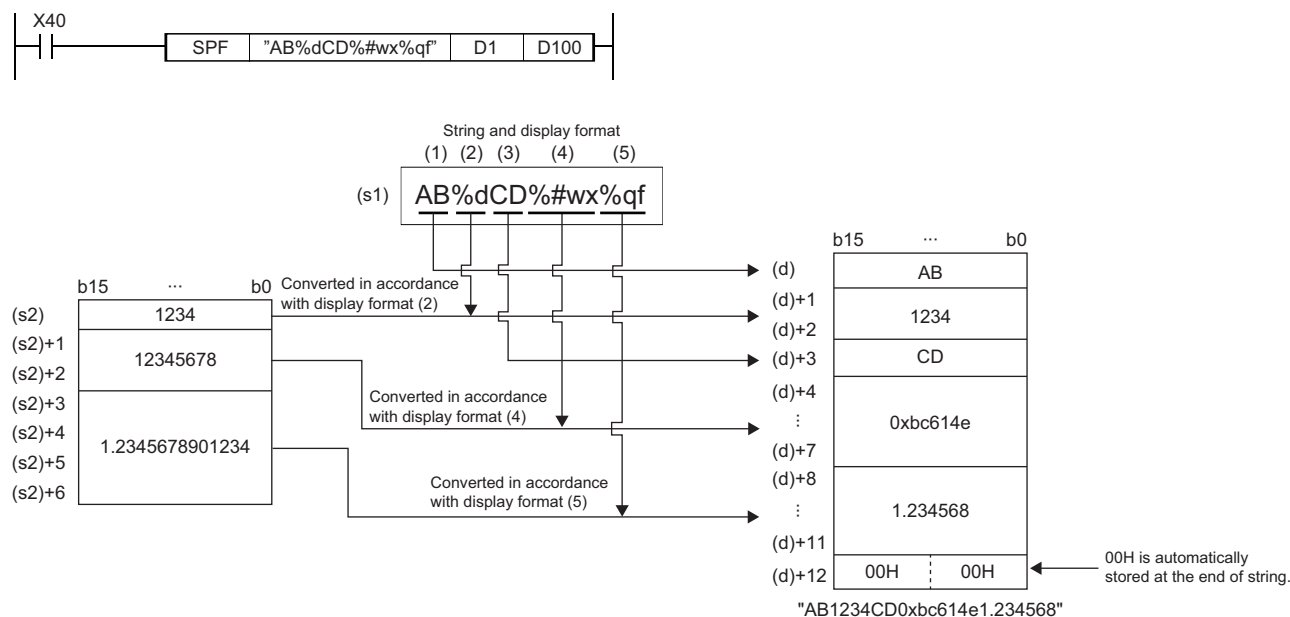


- If the converted string (d) ends with an even number of bytes, the NULL code "00H" is stored in the device (upper 8 bits and lower 8 bits) following the last device of the string. If the converted string (d) ends with an odd number of bytes, the NULL code "00H" is stored in the last device (upper 8 bits) of the string.

**Ex.**

When the SPF(P) instruction is executed while the data listed below is stored, the string stored in D100 and later is "AB1234CD0xbc614e1.234568".

| Operand | Stored data                                                                                                                                                                                                                                |                                                |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| (s1)    | AB%dCD%#wx%qf (string)<br>• The following display format is specified for the stored string.<br>AB (outputting the string) %d (D1 display format) CD (outputting the string) %#wx (D2 and D3 display format) %qf (D4 to D7 display format) |                                                |
| (s2)    | D1                                                                                                                                                                                                                                         | 1234 (decimal)                                 |
|         | D2 to D3                                                                                                                                                                                                                                   | 12345678 (decimal)                             |
|         | D4 to D7                                                                                                                                                                                                                                   | 1.2345678901234 (double-precision real number) |
| (d)     | D100                                                                                                                                                                                                                                       |                                                |



(1): The string "AB" is output.

(2): The display format: [Acquisition data size] = (Omitted), [Conversion specifier] = d Data is obtained from (s2) in units of one word, and output as a signed decimal number.

(3): The string "CD" is output.

(4): The display format: [Flag] = #, [Acquisition data size] = w, [Conversion specifier] = x Data is obtained from (s2)+1 in units of two words, prefixed with "0x", and output as an unsigned hexadecimal number.

(5): The display format: [Accuracy] = (Omitted), [Acquisition data size] = q, [Conversion specifier] = f Data is obtained from (s2)+3 in units of four words, and output as a double-precision real number in decimal notation. Since the description of [Accuracy] is omitted, a value with six digits after the decimal point is output, and the last digit of the output string is rounded off.



## ■Flag

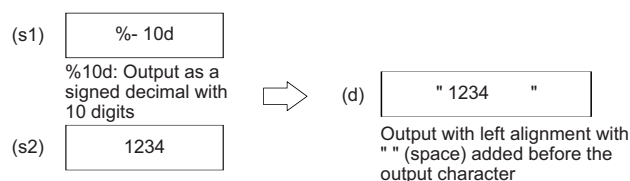
This item modifies the string to be output to (d) according to conditions.

| Specifier   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (Omitted)   | Outputs a string with right alignment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| -           | <p>When [Minimum field width] is larger than the number of converted characters obtained from (s2), the string is output with left alignment.</p> <div> <div>(s1) <code>%-10d</code></div> <div>%10d: Output as a signed decimal with 10 digits</div> <div>(s2) <code>1234</code></div> <div>⇒ (d) <code>"1234 "</code></div> <div>Output with left alignment</div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| +           | To output 0 or a positive number, add "+".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| " " (space) | To output 0 or a positive number, add " " (space).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| #           | <p>Outputs a string in the following output formats according to the [Conversion specifier] setting.</p> <ul style="list-style-type: none"> <li>• "o": Adds "0" to the beginning.</li> <li>• "x" or "X": Adds "0x" or "0X" to the beginning.</li> <li>• "f", "e", or "E": Always outputs a decimal point when a real number is output.</li> </ul> <div> <div>(s1) <code>%#.0wf</code></div> <div>%.0wf: Output as a single-precision real number in decimal notation and with no digits after the decimal point</div> <div>(s2) <code>1.234</code></div> <div>(s2)+1</div> <div>⇒ (d) <code>"1."</code></div> <div>"." (period) output</div> </div> <ul style="list-style-type: none"> <li>• "g" or "G": Always outputs a decimal point when a real number is output, and appends "0" for the number of significant digits to the end.</li> </ul> <div> <div>(s1) <code>%#wg</code></div> <div>%wg: Output as a single-precision real number in decimal notation and without "0"s after the decimal point</div> <div>(s2) <code>1.0</code></div> <div>(s2)+1</div> <div>⇒ (d) <code>"1.00000"</code></div> <div>Since [Accuracy] is omitted, up to six significant digits are output for the "0"s at the end.</div> </div> |
| 0           | <p>When [Minimum field width] is larger than the number of converted characters obtained from (s2), the output string is prefixed with "0" for output.</p> <div> <div>(s1) <code>%#06x</code></div> <div>%6x: Output as a hexadecimal with six digits</div> <div>(s2) <code>255</code></div> <div>⇒ (d) <code>"0x00ff"</code></div> <div>"0" output before the output string</div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

Multiple specifiers can be specified for [Flag]. There are no restrictions on the order to be used. However, when "+" and " " (space) are concurrently used, the content of the specifier "+" takes a priority for the output. If the same specifier is used, the second and subsequent specifications are ignored. If the specifiers "-" and "0" are specified simultaneously, the specifier "0" is ignored.

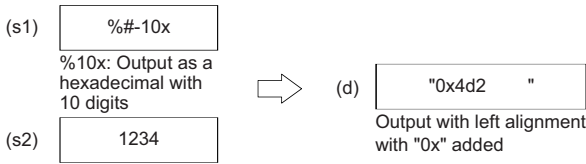
### Ex.

When "-" and " " (space) are used



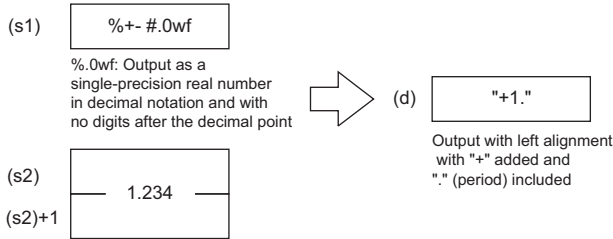
**Ex.**

When "#" and "-" are used



**Ex.**

When "+", "-", " " (space), and "#" are used



**■Minimum field width**

This item specifies the total number of characters to be output to (d), including the sign of the converted string, decimal point, exponent part, and " " (space).

| Specifier       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Numerical value | <div><ul style="list-style-type: none"><li>When this item is omitted, the number of characters for the retrieved data is specified for the output.</li></ul><div><div>(s1) <input type="text" value="%d"/></div><div>%d: Output as a signed decimal</div><div>➡ (d) <input type="text" value="1234"/></div><div>Since the description of a numerical value is omitted, a value with the number of output characters (four digits) is output.</div></div><div><div>(s2) <input type="text" value="1234"/></div></div><ul style="list-style-type: none"><li>When [Minimum field width] is equal to or less than the number of converted characters obtained from (s2), the specified [Minimum field width] is ignored.</li></ul><div><div>(s1) <input type="text" value="%3d"/></div><div>%d: Output as a signed decimal</div><div>➡ (d) <input type="text" value="1234"/></div><div>Four digits which are the number of output characters are output.</div><div>(s2) <input type="text" value="1234"/></div></div><ul style="list-style-type: none"><li>When [Minimum field width] is larger than the number of converted characters obtained from (s2), " " (space) is output before the numerical value.</li></ul><div><div>(s1) <input type="text" value="%10d"/></div><div>%d: Output as a signed decimal</div><div>➡ (d) <input type="text" value=" 1234"/></div><div>" " (space) output before the output character</div><div>(s2) <input type="text" value="1234"/></div></div></div> |

## ■Accuracy

Specifies the number of characters to be output to (d) with [Conversion specifier] from the data stored in (s2).

To indicate the accuracy, add the numerical value after "." (period). When only "." (period) is described and the numerical value is omitted, the operation is the same as when ".0" is specified.

| Specifier                       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "." (period)<br>numerical value | <p>■When [Conversion specifier] is "c"<br/>The specified [Accuracy] is ignored.</p> <p>■When [Conversion specifier] is "d", "u", "x", "X", or "o"<br/>The number of output characters is specified.</p> <ul style="list-style-type: none"> <li>When the specified numerical value is equal to or less than the number of converted characters obtained from (s2), the specified [Accuracy] is ignored.</li> </ul> <p>(s1) <input type="text" value="%.3d"/><br/>%d: Output as a signed decimal</p> <p>(d) <input type="text" value="1234"/><br/>Four digits which are the number of output characters are output.</p> <p>(s2) <input type="text" value="1234"/></p> <ul style="list-style-type: none"> <li>When the specified numerical value is larger than the number of converted characters obtained from (s2), the output string is prefixed with "0" for output.</li> </ul> <p>(s1) <input type="text" value="%.5d"/><br/>%d: Output as a signed decimal</p> <p>(d) <input type="text" value="01234"/><br/>"0" output before the output string</p> <p>(s2) <input type="text" value="1234"/></p> <ul style="list-style-type: none"> <li>When [Accuracy] is specified as "0" and the conversion data specified in (s2) is "0", no string is output.</li> </ul> <p>(s1) <input type="text" value="%.0d"/><br/>%d: Output as a signed decimal</p> <p>(d) <input type="text" value=""/></p> <p>(s2) <input type="text" value="0"/></p> <p>■When [Conversion specifier] is "f", "e", or "E"<br/>The number of output characters for digits after the decimal point is specified.</p> <ul style="list-style-type: none"> <li>When the description of a numerical value is omitted, a value with six digits after the decimal point is output, and the last digit of the output string is rounded off.</li> </ul> <p>(s1) <input type="text" value="%.3wf"/><br/>%wf: Output as a single-precision real number in decimal notation</p> <p>(d) <input type="text" value="1.235"/><br/>Since the description of a numerical value is omitted, a value with three digits after the decimal point is output.</p> <p>(s2) <input type="text" value="1.2345"/></p> <p>(s2)+1</p> <ul style="list-style-type: none"> <li>When the specified numerical value is larger than the number of converted characters obtained from (s2), "0" is added for output. However, a character other than "0" may be output depending on the conversion data in the device specified by (s2). In addition, 0 will be appended after the output string when decimal notation is used, and appended after the output string and before "e" or "E" when exponential notation is used.</li> </ul> <p>(s1) <input type="text" value="%+-#.0wf"/><br/>%we: Output as a single-precision real number in exponential notation</p> <p>(d) <input type="text" value="1.23400e+00"/><br/>"0" output after the output string and before "e"</p> <p>(s2) <input type="text" value="1.234"/></p> <p>(s2)+1</p> |

| Specifier                       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "." (period)<br>numerical value | <div>■When [Conversion specifier] is "g" or "G"</div> <div>The number of significant digits is specified.</div> <div><ul style="list-style-type: none"><li>When the description of a numerical value is omitted, six significant digits are output, and the last digit of the output string is rounded off.</li></ul></div> <div><div><div>(s1)</div><div><div>%3wg</div></div></div><div><div>%wg: Output as a single-precision real number in decimal notation</div></div></div> <div><div>(s2)</div><div><div>1.2345</div></div></div> <div><div>(s2)+1</div></div> <div><div>⇒</div><div><div>(d)</div><div><div>"1.23"</div></div></div><div><div>Output with three significant digits</div></div></div> <div><ul style="list-style-type: none"><li>When [Accuracy] is specified as ".0", it is equal to when ".1" is specified.</li></ul><div>When 1.234 is specified in (s2), it is output as shown below.</div><div><div><div>(s1)</div><div><div>%0qg</div></div></div><div><div>%qg: Output as a double-precision real number in exponential notation</div></div></div><div><div>(s2)</div><div><div>1.234</div></div></div><div><div>(s2)+1</div></div><div><div>(s2)+2</div></div><div><div>(s2)+3</div></div></div> <div><div>⇒</div><div><div>(d)</div><div><div>"1"</div></div></div><div><div>A value with one significant digit is output.</div></div></div> <div><div>When 0.1234 is specified in (s2), it is output as shown below.</div><div><div><div>(s1)</div><div><div>%0qg</div></div></div><div><div>%qg: Output as a double-precision real number in exponential notation</div></div></div><div><div>(s2)</div><div><div>0.1234</div></div></div><div><div>(s2)+1</div></div><div><div>(s2)+2</div></div><div><div>(s2)+3</div></div></div> <div><div>⇒</div><div><div>(d)</div><div><div>"0.1"</div></div></div><div><div>A value with one significant digit is output.</div></div></div> <div><div>■When [Conversion specifier] is "s"</div><div>The string for the specified number of characters is output in the order of the string data stored in (s2).</div><div><ul style="list-style-type: none"><li>When the number of output characters is larger than the number of characters for the string data retrieved from (s2), the string is output for the number of characters for the string data retrieved by (s2).</li></ul></div><div><div><div>(s1)</div><div><div>%10s</div></div></div><div><div>b15 ..... b8 b7 ..... b1</div></div><div><div>(s2)</div><div><div>42H(B)41H(A)</div></div></div><div><div>(s2)+1</div><div><div>44H(D)43H(C)</div></div></div><div><div>(s2)+2</div><div><div>00H45H(E)</div></div></div></div><div><div>⇒</div><div><div>(d)</div><div><div>"ABCDE"</div></div></div><div><div>Five characters which are the number of characters of the data obtained from (s2) are output.</div></div></div><div><ul style="list-style-type: none"><li>When the number of output characters is smaller than the number of characters for the string data retrieved from (s2), the string is output for the number of output characters.</li></ul><div><div><div>(s1)</div><div><div>%3s</div></div></div><div><div>b15 ..... b8 b7 ..... b1</div></div><div><div>(s2)</div><div><div>42H(B)41H(A)</div></div></div><div><div>(s2)+1</div><div><div>44H(D)43H(C)</div></div></div><div><div>(s2)+2</div><div><div>00H45H(E)</div></div></div></div><div><div>⇒</div><div><div>(d)</div><div><div>"ABC"</div></div></div><div><div>Three characters which are the number of output characters are output.</div></div></div></div></div> |

■Acquisition data size

This item specifies how many words of the data stored in (s2) are to be converted and output to (d).

| Specifier | Description                                                                                                                                                                                                                                                                                                                   |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (Omitted) | <p>Retrieves (s2) in units of one word.</p> <div> <div>(s1) <div>%d</div></div> <div> <div>%d: Output as a signed decimal</div> <div>→</div> <div>(d) <div>"722"</div></div> </div> <div> <div>(s2) <div>02D2H</div></div> <div>← One word of data converted</div> <div>(s2)+1 <div>4996H</div></div> </div> </div>           |
| w         | <p>Retrieves (s2) in units of two words.</p> <div> <div>(s1) <div>%wd</div></div> <div> <div>%d: Output as a signed decimal</div> <div>→</div> <div>(d) <div>"1234567890"</div></div> </div> <div> <div>(s2) <div>02D2H</div></div> <div>← Two words of data converted</div> <div>(s2)+1 <div>4996H</div></div> </div> </div> |
| q         | <p>Retrieves (s2) in units of four words.</p>                                                                                                                                                                                                                                                                                 |

## ■Conversion specifier

This item specifies the output format of the string to be output to (d).

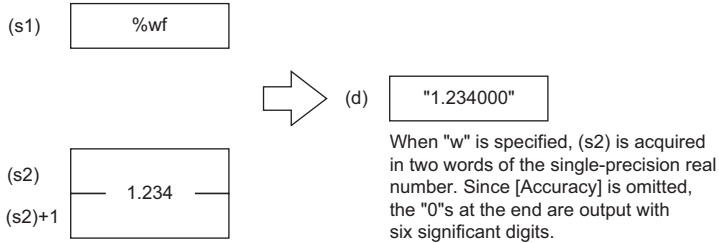
| Specifier | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| d         | Outputs a string as a signed decimal number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| u         | Outputs a string as an unsigned decimal number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| x         | Outputs a string as an unsigned hexadecimal number. Numbers 10 to 15 are displayed as "a" to "f".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| X         | Outputs a string as an unsigned hexadecimal number. Numbers 10 to 15 are displayed as "A" to "F".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| o         | Outputs a string as an unsigned octal number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| s         | <p>Retrieves the string data stored in (s2) up to 00H (NULL) and outputs it. If 00H (NULL) does not exist, an error (error code: 2820H) occurs.</p> <div> <div>(s1) <span style="border: 1px solid black; padding: 2px 10px;">%s</span></div> <div> <div> <div>b15 .....</div> <div>b8 b7 .....</div> <div>b1</div> </div> <div> <div>(s2) <span style="border: 1px solid black; padding: 2px 10px;">42H(B) 41H(A)</span></div> <div>(s2)+1 <span style="border: 1px solid black; padding: 2px 10px;">44H(D) 43H(C)</span></div> <div>(s2)+2 <span style="border: 1px solid black; padding: 2px 10px;">45H(E) 00H</span> ← Obtained up to NULL</div> <div>(s2)+3 <span style="border: 1px solid black; padding: 2px 10px;">47H(G) 46H(F)</span></div> </div> </div> <div> <div>→ (d) <span style="border: 1px solid black; padding: 2px 10px;">"ABCD"</span></div> </div> <p>When 00H (NULL) is stored in the lower 1 byte (b1 to b7), the next conversion data is valid from the data specified in the subsequent device.</p> <div> <div>(s1) <span style="border: 1px solid black; padding: 2px 10px;">%s%c</span></div> <div> <div> <div>b15 .....</div> <div>b8 b7 .....</div> <div>b1</div> </div> <div> <div>(s2) <span style="border: 1px solid black; padding: 2px 10px;">42H(B) 41H(A)</span></div> <div>(s2)+1 <span style="border: 1px solid black; padding: 2px 10px;">44H(D) 43H(C)</span></div> <div>(s2)+2 <span style="border: 1px solid black; padding: 2px 10px;">45H(E) 00H</span></div> <div>(s2)+3 <span style="border: 1px solid black; padding: 2px 10px;">47H(G) 46H(F)</span> ← Conversion data specified by %c</div> </div> </div> <div> <div>→ (d) <span style="border: 1px solid black; padding: 2px 10px;">"ABCD"</span></div> </div> </div></div> |
| c         | <p>Retrieves the string data stored in (s2) as ASCII code (decimal) in units of one word, converts it to a string, and outputs it.</p> <div> <div>(s1) <span style="border: 1px solid black; padding: 2px 10px;">%c</span></div> <div> <div>→ (d) <span style="border: 1px solid black; padding: 2px 10px;">"A"</span></div> <div>ASCII code output as a character</div> </div> <div> <div>(s2) <span style="border: 1px solid black; padding: 2px 10px;">65</span></div> </div> <p>The conversion data stored in (s2) is valid only for the lower one byte (b1 to b7).</p> <div> <div>(s1) <span style="border: 1px solid black; padding: 2px 10px;">%c</span></div> <div> <div>→ (d) <span style="border: 1px solid black; padding: 2px 10px;">"A"</span></div> <div>Only the lower one-byte character ("A") output</div> </div> <div> <div>(s2) <span style="border: 1px solid black; padding: 2px 10px;">16961</span></div> <div>ASCII code (decimal) indicating "AB"</div> </div> </div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| f         | Outputs a string in decimal notation. The maximum number of significant digits will be 7 for single-precision real numbers and 15 for double-precision real numbers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| e         | Outputs a string in exponential notation, with the exponent indicated by "e". The maximum number of significant digits will be 7 for single-precision real numbers and 15 for double-precision real numbers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| E         | Outputs a string in exponential notation, with the exponent indicated by "E". The maximum number of significant digits will be 7 for single-precision real numbers and 15 for double-precision real numbers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

| Specifier | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| g         | <p>Outputs a value in either decimal notation or exponential notation, depending on the magnitude of the numerical value. The exponent is indicated by "e". However, if the value in the exponent part of the conversion data specified in (s2) is equal to or larger than the numerical value specified in [Accuracy], the value is output in exponential notation.</p> <ul style="list-style-type: none"> <li>• Absolute value of numerical value 0.0001 or more: Decimal notation</li> <li>• Numerical value less than 0.0001: Exponential notation</li> </ul> <p>The maximum number of significant digits will be 7 for single-precision real numbers and 15 for double-precision real numbers.</p> <p>■ When the conversion data specified in (s2) is 0.0001 or more and the value is output in decimal notation</p> <div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"> <p>(s1) <span style="border: 1px solid black; padding: 2px 10px;">%wg</span></p> <p>Since [Accuracy] is omitted, the value is output with six significant digits.</p> </div> <div style="margin-right: 20px;">➔</div> <div> <p>(d) <span style="border: 1px solid black; padding: 2px 10px;">"0.0001"</span></p> <p>Since the exponent - 4 of (s2) is smaller than the number of significant digits of [Accuracy], the value is output in decimal notation.</p> </div> </div> <div style="margin-top: 20px;"> <p>(s2) <span style="border: 1px solid black; padding: 2px 10px;">0.0001</span></p> <p>(s2)+1 <span style="border: 1px solid black; padding: 2px 10px;">(1e-4)</span></p> </div> <p>■ When the conversion data specified in (s2) is 0.0001 or more and the value is output in exponential notation</p> <div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"> <p>(s1) <span style="border: 1px solid black; padding: 2px 10px;">%qg</span></p> <p>Since [Accuracy] is omitted, the value is output with six significant digits.</p> </div> <div style="margin-right: 20px;">➔</div> <div> <p>(d) <span style="border: 1px solid black; padding: 2px 10px;">"1.23457e+06"</span></p> <p>Since the exponent + 6 of (s2) is equal to or larger than six significant digits of [Accuracy], the value is output in exponential notation.</p> </div> </div> <div style="margin-top: 20px;"> <p>(s2) <span style="border: 1px solid black; padding: 2px 10px;">1234567.12</span></p> <p>(s2)+1 <span style="border: 1px solid black; padding: 2px 10px;">(1.23456712e+6)</span></p> <p>(s2)+2 <span style="border: 1px solid black; padding: 2px 10px;"></span></p> <p>(s2)+3 <span style="border: 1px solid black; padding: 2px 10px;"></span></p> </div> |
| G         | <p>Outputs a value in either decimal notation or exponential notation, depending on the magnitude of the numerical value. The exponent is indicated by "E". However, if the value in the exponent part of the conversion data specified in (s2) is equal to or larger than the numerical value specified in [Accuracy], the value is output in exponential notation.</p> <ul style="list-style-type: none"> <li>• Absolute value of numerical value 0.0001 or more: Decimal notation</li> <li>• Numerical value less than 0.0001: Exponential notation</li> </ul> <p>The maximum number of significant digits will be 7 for single-precision real numbers and 15 for double-precision real numbers.</p> <div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"> <p>(s1) <span style="border: 1px solid black; padding: 2px 10px;">%wG</span></p> </div> <div style="margin-right: 20px;">➔</div> <div> <p>(d) <span style="border: 1px solid black; padding: 2px 10px;">"-9.99E-05"</span></p> <p>Output in exponential notation</p> </div> </div> <div style="margin-top: 20px;"> <p>(s2) <span style="border: 1px solid black; padding: 2px 10px;">-0.0000999</span></p> <p>(s2)+1 <span style="border: 1px solid black; padding: 2px 10px;"></span></p> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

When "f", "e", "E", "g", or "G" is used in [Conversion specifier], the output format can be selected from single-precision real number or double-precision real number by the specifier of [Acquisition data size]. When [Acquisition data size] is specified as "w", a single-precision real number is output, and when [Acquisition data size] is specified as "q", a double-precision real number is output.

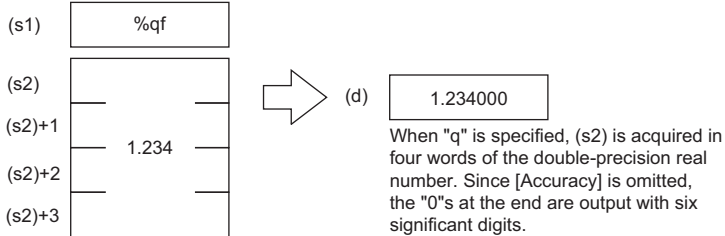
**Ex.**

To output as a single-precision real number



**Ex.**

To output as a double-precision real number



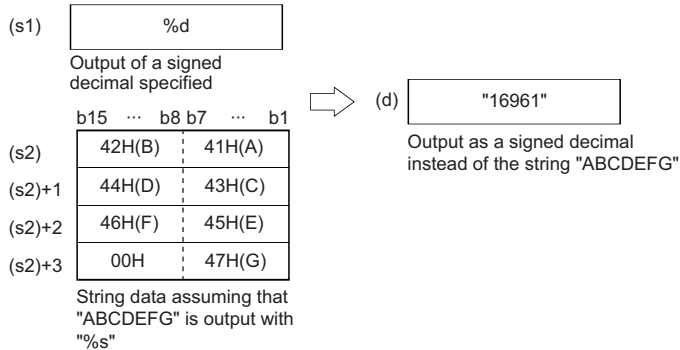


## Precautions

The combination of display format items and the format of the data to be converted must always match. Otherwise, an unintended string will be output.

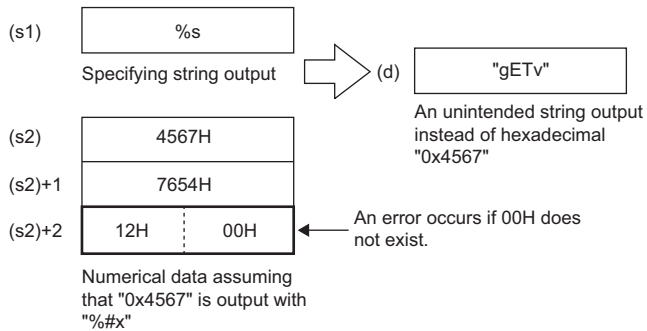
### Ex.

When the conversion target data is string data but the display format is numerical data



### Ex.

When the conversion target data is numerical data but the display format is string data

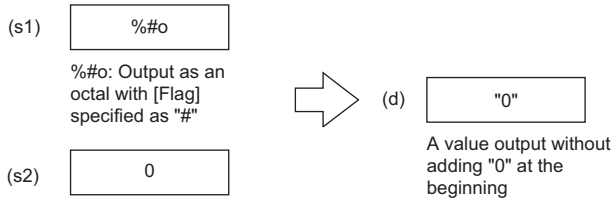


## ■Flag

- When [Conversion specifier] is "s", the specified [Flag] is ignored.
- When [Minimum field width] is equal to or less than the number of converted characters obtained from (s2), the specifier "-" is ignored.
- When [Conversion specifier] is "u", "x", "X", "o", "s", or "c", the specifiers "+" and " " (space) are ignored.
- When [Conversion specifier] is "d", "u", "s", or "c", or when [Conversion specifier] is specified as "o", "x", or "X" and "0" is specified in (s2), the specifier "#" is ignored.

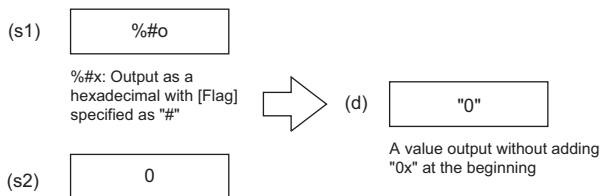
### Ex.

When "o" is specified in [Conversion specifier] and "#" is specified in [Flag], the output is as follows.



### Ex.

When "x" is specified in [Conversion specifier] and "#" is specified in [Flag], the output is as follows.



- Ignored if a value other than 0 or a positive number is output when "+" and " " (space) are used.
- "-" is added at the beginning when "+" is not specified and a negative number is output.

## ■Minimum field value

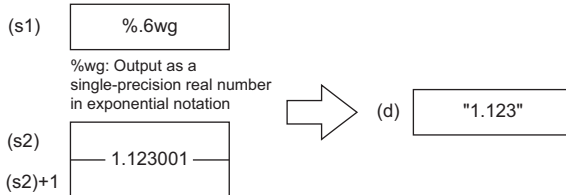
If the specified [Minimum field width] exceeds 255 characters, an error (error code: 329CH) occurs.

## ■Accuracy

- If the specified [Accuracy] exceeds 255 characters, an error (error code: 329CH) occurs.
- When [Conversion specifier] is "g" or "G", "0"s at the end after the decimal point are not output. "." (period) is also not displayed if there is no numerical value after the decimal point.

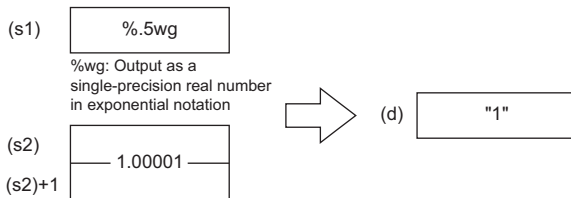
### Ex.

When the number of significant digits is six, 0s at the end after the decimal point (0s at the fourth and fifth places after the decimal point) are not output.



### Ex.

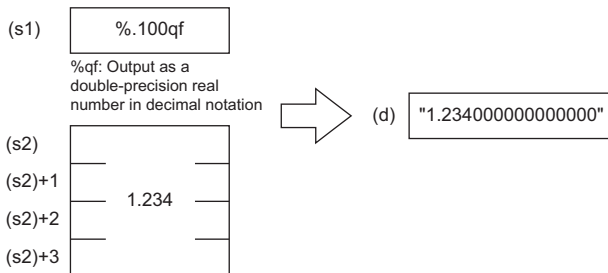
When the number of significant digits is five, "." (period) is not output because all the digits after the decimal point are 0s (no numerical values).



- When [Conversion specifier] is "f", "e", "E", "g", or "G" and the numerical value specified in [Accuracy] is larger than the maximum number of significant digits of the output result, the value is output with the maximum number of significant digits.

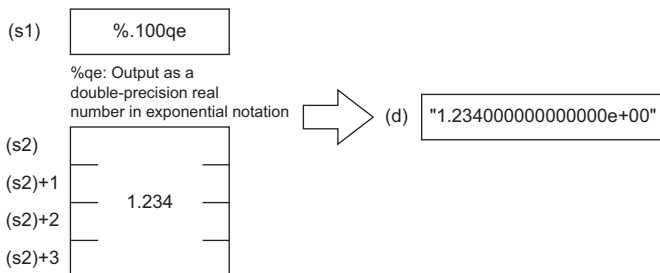
### Ex.

When "f" is specified in [Conversion specifier] and the numerical value specified in [Accuracy] is larger than the maximum number of significant digits of the double-precision real number, the value is output with the maximum number of significant digits (15 digits) of the double-precision real number.



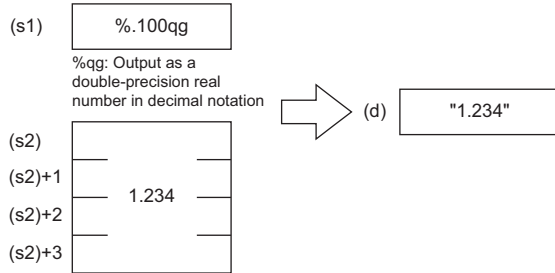
### Ex.

When "e" is specified in [Conversion specifier] and the numerical value specified in [Accuracy] is larger than the maximum number of significant digits of the double-precision real number, the value is output with the maximum number of significant digits (15 digits) of the double-precision real number.

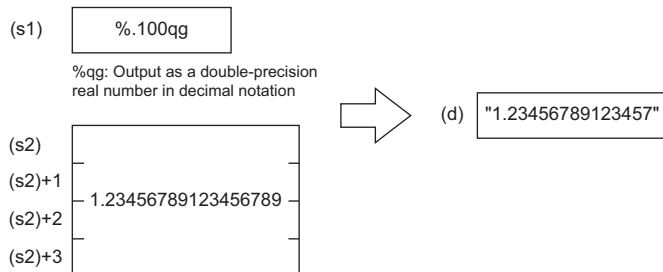


**Ex.**

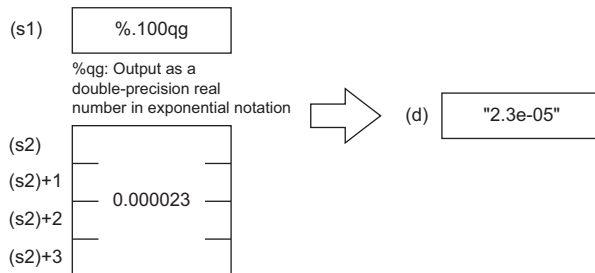
When "g" is specified in [Conversion specifier], the numerical value specified in [Accuracy] is larger than the maximum number of significant digits of the double-precision real number, and the number of digits of the numerical value stored in (s2) is equal to or less than the maximum number of significant digits, "0"s at the end after the decimal point are not output.

**Ex.**

When "g" is specified in [Conversion specifier], the numerical value specified in [Accuracy] is larger than the maximum number of significant digits of the double-precision real number, and the number of digits of the numerical value stored in (s2) is equal to or larger than the maximum number of significant digits, the value is output with the maximum number of significant digits (15 digits) which is obtained by rounding off the 16th digit.

**Ex.**

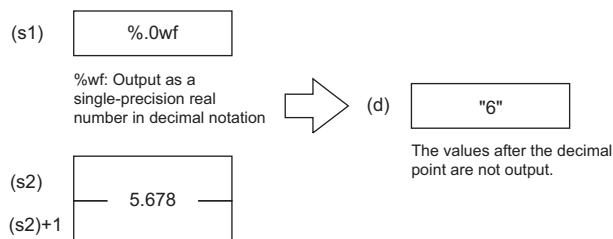
When "g" is specified in [Conversion specifier], the numerical value specified in [Accuracy] is larger than the maximum number of significant digits of the double-precision real number, and the value is output in exponential notation, "0"s at the end after the decimal point are not output.



- When "f", "e", or "E" is specified in [Conversion specifier], ".0" is specified in [Accuracy], and "#" is not specified in [Flag], the digits after the decimal point are not output.

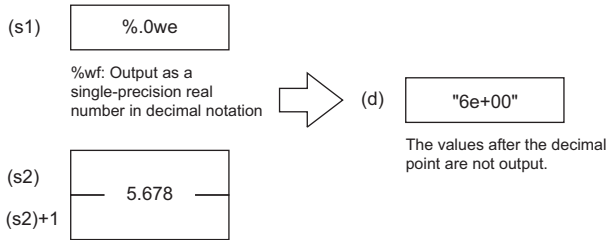
**Ex.**

When [Conversion specifier] is "f", the expression is as follows if ".0" is specified in [Flag].



**Ex.**

When [Conversion specifier] is "e", the expression is as follows if ".0" is specified in [Flag].



- When [Conversion specifier] is "d", "f", "e", "E", "g", or "G", the sign of the converted string is not included in the number of output characters specified in [Accuracy].

**Acquisition data size**

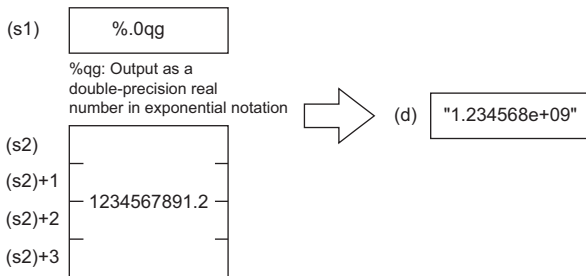
- When [Conversion specifier] is "s" or "c", the specified [Acquisition data size] is ignored.
- When [Conversion specifier] is "f", "e", "E", "g", or "G", always specify "w" or "q" in [Acquisition data size]. If the description is omitted, an error (error code: 3299H) occurs.

**Conversion specifier**

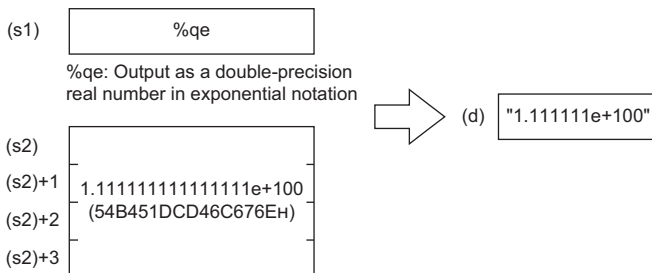
When a string is output in exponential notation, an exponent with two or more digits is output.

**Ex.**

When the data stored in (s2) is expressed exponentially and the number of digits of the exponent part is two, the exponent part is output as two digits as follows.

**Ex.**

When the data stored in (s2) is expressed exponentially and the number of digits of the exponent part is three, the exponent part is output as three digits as follows.



## Operation error

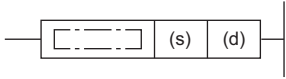
| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | 00H does not exist between the device number specified by (s2) and the last device number of the relevant device.<br>(When [Conversion specifier] is specified as "s")                                                                                                                                                                                                    |
|                  | The size specified by (s2) + [Acquisition data size] exceeds the end device number of (s2).<br>(When [Conversion specifier] is not specified as "s")                                                                                                                                                                                                                      |
|                  | 00H does not exist between the device number specified by (s1) and the last device number of the relevant device.                                                                                                                                                                                                                                                         |
| 2821H            | The device numbers for storing the strings in the devices specified by (s1) and (d) are overlapping.                                                                                                                                                                                                                                                                      |
| 3285H            | The number of characters of the string in the device specified by (s1) exceeds 255.                                                                                                                                                                                                                                                                                       |
| 3298H            | The following display format is used for (s1). <ul style="list-style-type: none"> <li>• A specifier that cannot be used is used.</li> <li>• The order of the display format is not the specified one.</li> <li>• [Accuracy] or [Acquisition data size] is used multiple times for a single display format.</li> </ul>                                                     |
| 3299H            | The display format is not specified for (s1).                                                                                                                                                                                                                                                                                                                             |
| 329AH            | The number of characters of the string in the device specified by (s2) exceeds 255.<br>(When [Conversion specifier] is specified as "s")                                                                                                                                                                                                                                  |
| 3286H            | The string stored in the device specified by (d) is out of the output enable range. <ul style="list-style-type: none"> <li>• The number of characters in the concatenated string exceeds 255.</li> <li>• The entire string that was converted in the assignment range of the relevant device/label for the specified device number and later cannot be stored.</li> </ul> |
| 329CH            | The specified [Minimum field width] or [Accuracy] exceeds 255 characters.                                                                                                                                                                                                                                                                                                 |

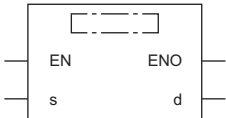
# Converting Unicode string to Shift JIS string

16

## WS2SJIS(P)

These instructions convert a Unicode string to a Shift JIS string.

| Ladder                                                                            | ST                                                      |
|-----------------------------------------------------------------------------------|---------------------------------------------------------|
|  | <pre>ENO:=WS2SJIS(EN,s,d); ENO:=WS2SJISP(EN,s,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| WS2SJIS     |  |
| WS2SJISP    |  |

### Setting data

### Description, range, data type

| Operand | Description                                        | Range | Data type      | Data type (label) |
|---------|----------------------------------------------------|-------|----------------|-------------------|
| (s)     | Start device containing the string to be converted | —     | Unicode string | ANYSTRING_DOUBLE  |
| (d)     | Start device for storing the converted string      | —     | String         | ANYSTRING_SINGLE  |
| EN      | Execution condition                                | —     | Bit            | BOOL              |
| ENO     | Execution result                                   | —     | Bit            | BOOL              |

### Applicable devices

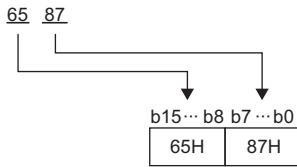
| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the Unicode string in the device specified by (s) to the shift JIS string, and stores the converted data in the device specified by (d).
- The Unicode string in the device specified by (s) should be specified in little endian.

**Ex.**

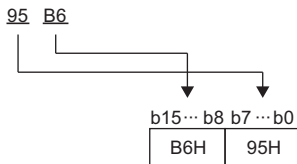
A Unicode string "6587H" is specified with "6587H".



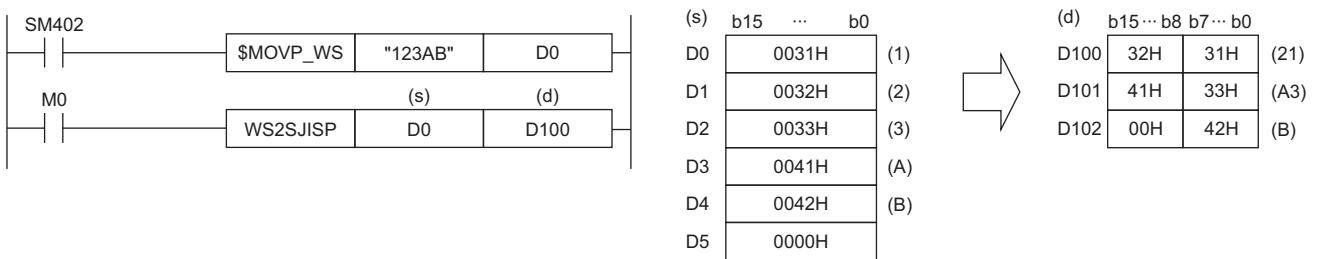
- The shift JIS string in (d) is stored in big endian.

**Ex.**

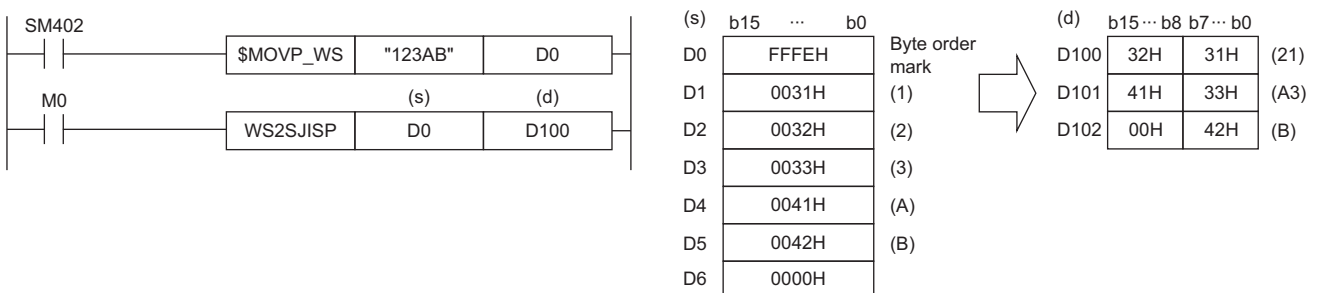
A shift JIS string "95B6H" is specified with "B695H".



- When a byte order mark is not used, conversion from Unicode to shift JIS occurs as follows.



- When a byte order mark (FEFFH) is added, conversion from Unicode to shift JIS occurs as follows.



## Operation error

| Error code (SD0) | Description                                                                                                                                                                                       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The ranges of data in the devices specified by (s) and (d) are overlapping.                                                                                                                       |
| 3281H            | Byte order mark FEFFH (big endian) is added to the string in the device specified by (s).<br>The range of data in the device specified by (s) includes a character code that cannot be converted. |
| 3285H            | The string in the device specified by (s) exceeds 16383 characters.*1                                                                                                                             |
| 3286H            | The entire string that was converted in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored.                                      |

\*1 A two-byte character such as a kanji character represented in shift JIS code should be counted as 2.



# Converting Shift JIS string to Unicode string (without byte order mark)

## SJIS2WS(P)

These instructions convert a Shift JIS string to a Unicode string.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | ENO:=SJIS2WS(EN,s,d);<br>ENO:=SJIS2WSP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SJIS2WS     |                     |
| SJIS2WSP    |                     |

### Setting data

### Description, range, data type

| Operand | Description                                        | Range | Data type      | Data type (label) |
|---------|----------------------------------------------------|-------|----------------|-------------------|
| (s)     | Start device containing the string to be converted | —     | String         | ANYSTRING_SINGLE  |
| (d)     | Start device for storing the converted string      | —     | Unicode string | ANYSTRING_DOUBLE  |
| EN      | Execution condition                                | —     | Bit            | BOOL              |
| ENO     | Execution result                                   | —     | Bit            | BOOL              |

### Applicable devices

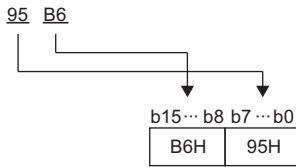
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the shift JIS string in the device specified by (s) to a Unicode string, and store the converted data in the device specified by (d).
- The shift JIS string in the device specified by (s) should be specified in big endian.

**Ex.**

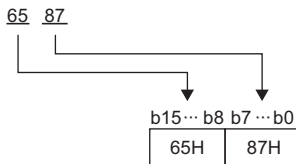
A shift JIS string "95B6H" is specified with "B695H".



- The Unicode string in (d) is stored in little endian.

**Ex.**

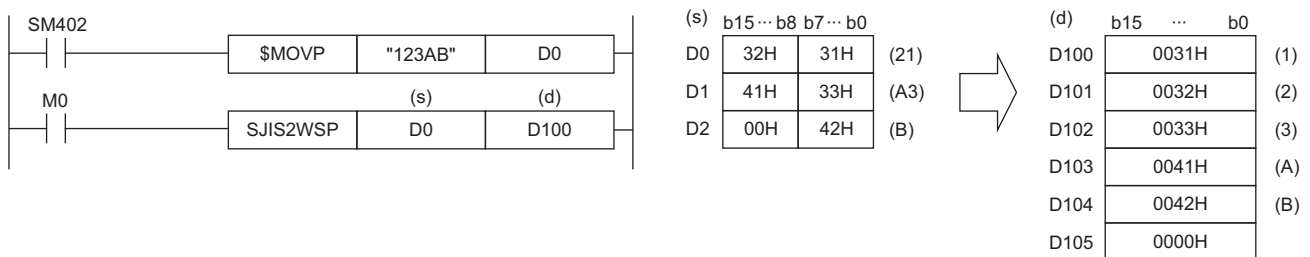
A Unicode string "6587H" is specified with "6587H".



- The SJIS2WS(P) instruction does not add a byte order mark to the beginning of the data in the device specified by (d). To add a byte order mark, use the SJIS2WSB(P) instruction.

Page 793 SJIS2WSB(P)

- The following figure shows the operation for converting shift JIS to Unicode.



## Operation error

| Error code (SD0) | Description                                                                                                                                                  |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The ranges of data in the devices specified by (s) and (d) are overlapping.                                                                                  |
| 3281H            | The range of data in the device specified by (s) includes a character code that cannot be converted.                                                         |
| 3285H            | The string in the device specified by (s) exceeds 16383 characters.*1                                                                                        |
| 3286H            | The entire string that was converted in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored. |

\*1 A two-byte character such as a kanji character represented in shift JIS code should be counted as 2.

# Converting shift JIS string to Unicode (with byte order mark)

## SJIS2WSB(P)

These instructions convert a shift JIS string to a Unicode string, and adds a byte order mark to the start of the converted data.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=SJIS2WSB(EN,s,d); ENO:=SJIS2WSBP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SJIS2WSB    |                     |
| SJIS2WSBP   |                     |

### Setting data

### Description, range, data type

| Operand | Description                                        | Range | Data type      | Data type (label) |
|---------|----------------------------------------------------|-------|----------------|-------------------|
| (s)     | Start device containing the string to be converted | —     | String         | ANYSTRING_SINGLE  |
| (d)     | Start device for storing the converted string      | —     | Unicode string | ANYSTRING_DOUBLE  |
| EN      | Execution condition                                | —     | Bit            | BOOL              |
| ENO     | Execution result                                   | —     | Bit            | BOOL              |

### Applicable devices

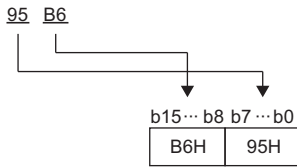
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the shift JIS string in the device specified by (s) to the Unicode string, add a byte order mark to the start of the converted data, and store it in the device specified by (d).
- The shift JIS string in the device specified by (s) should be specified in big endian.

**Ex.**

A shift JIS string "95B6H" is specified with "B695H".



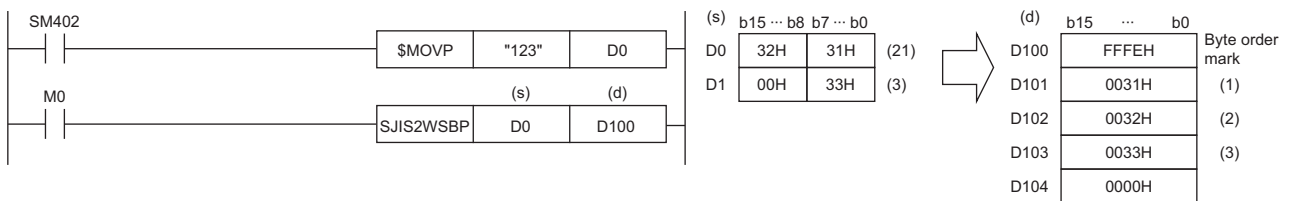
- The Unicode string in (d) is stored in little endian.

**Ex.**

A Unicode string "6587H" is specified with "6587H".



- The following figure shows the operation for converting shift JIS to Unicode.



## Operation error

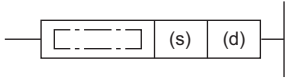
| Error code (SD0) | Description                                                                                                                                                  |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2821H            | The ranges of data in the devices specified by (s) and (d) are overlapping.                                                                                  |
| 3281H            | The range of data in the device specified by (s) includes a character code that cannot be converted.                                                         |
| 3285H            | The string in the device specified by (s) exceeds 16383 characters.*1                                                                                        |
| 3286H            | The entire string that was converted in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored. |

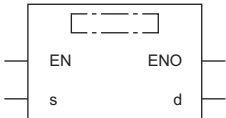
\*1 A two-byte character such as a kanji character represented in shift JIS code should be counted as 2.

## Detecting a string length

### LEN(P)

These instructions detect the length of the specified string.

| Ladder                                                                            | ST <sup>*1</sup>   |
|-----------------------------------------------------------------------------------|--------------------|
|  | ENO:=LENP(EN,s,d); |

| FBD/LD <sup>*1</sup>                                                              |
|-----------------------------------------------------------------------------------|
|  |

<sup>\*1</sup> The LEN instruction does not support the ST and FBD/LD. Use the standard function, LEN.

 Page 1371 LEN(\_E)

### ■Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| LEN         |   |
| LENP        |  |

### Setting data

### ■Description, range, data type

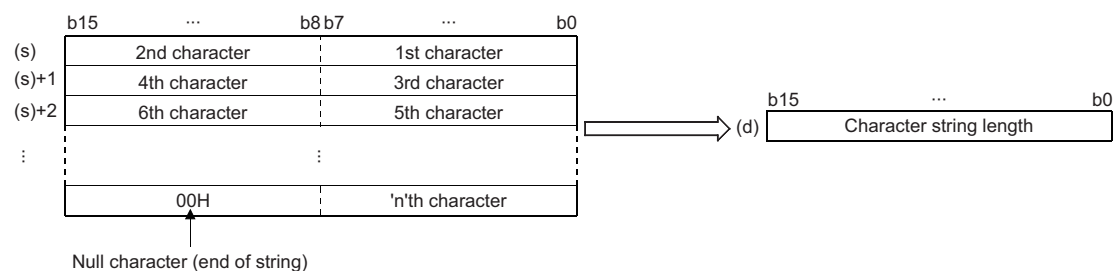
| Operand | Description                                                        | Range | Data type            | Data type (label) |
|---------|--------------------------------------------------------------------|-------|----------------------|-------------------|
| (s)     | Character string or the start device containing the string         | —     | String               | ANYSTRING_SINGLE  |
| (d)     | Number of the device for storing the length of the detected string | —     | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                | —     | Bit                  | BOOL              |
| ENO     | Execution result                                                   | —     | Bit                  | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |

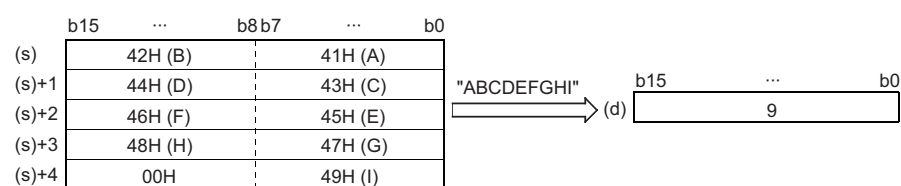
## Processing details

These instructions detect the length of the string in the device specified by (s) and store it in the device number specified by (d) and later. The data stored in device numbers starting from the one specified by (s) to the one containing 00H is processed as a string.



### Ex.

When "ABCDEFGHI" is stored in the device specified by (s) and later



## Operation error

| Error code (SD0) | Description                                                                                                                            |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) set in the assignment range of the relevant device/label for the device number specified by (s) and later. |
| 3285H            | The number of characters in the string specified by (s) exceeds 16383.                                                                 |

## Extracting string data from the right

### RIGHT(P)

These instructions extract (n) characters of data from the right of string data.

| Ladder   | ST*1                   |
|----------|------------------------|
|          | ENO:=RIGHTP(EN,s,n,d); |
| FBD/LD*1 |                        |
|          |                        |

\*1 The RIGHT instruction does not support the ST and FBD/LD. Use the standard function, RIGHT.

Page 1373 LEFT(\_E), RIGHT(\_E)

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| RIGHT       |                     |
| RIGHTP      |                     |

### Setting data

### Descriptions, ranges, and data types

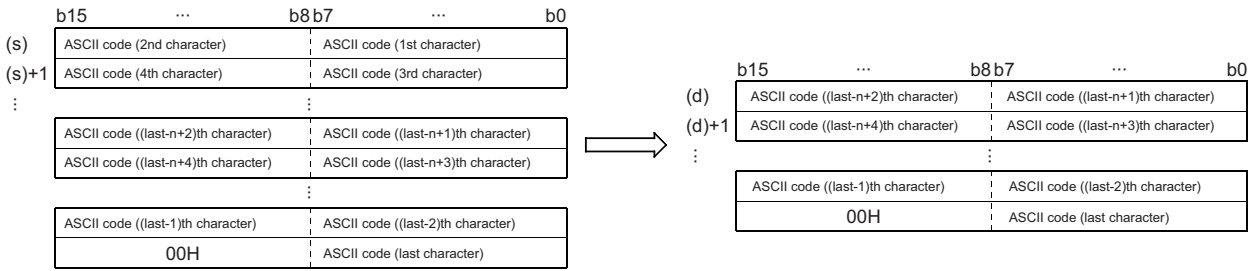
| Operand | Description                                                                                                           | Range      | Data type            | Data type (label) |
|---------|-----------------------------------------------------------------------------------------------------------------------|------------|----------------------|-------------------|
| (s)     | Character string or the start device containing the string                                                            | —          | String               | ANYSTRING_SINGLE  |
| (d)     | Start device for storing (n) characters of string extracted from the right of the data in the device specified by (s) | —          | String               | ANYSTRING_SINGLE  |
| (n)     | Number of characters to be extracted                                                                                  | 1 to 16383 | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                                                                   | —          | Bit                  | BOOL              |
| ENO     | Execution result                                                                                                      | —          | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

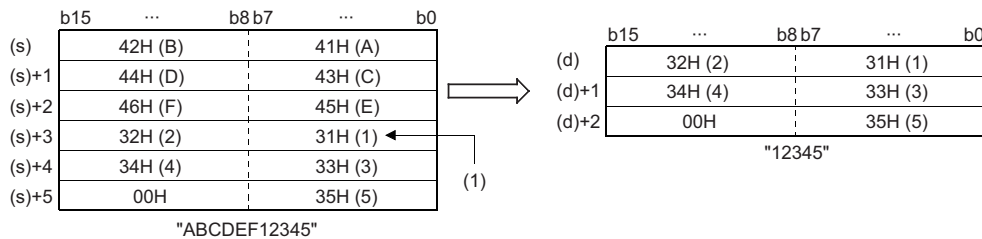
## Processing details

- These instructions extract (n) characters of data from the right of the string data (the end of the string) stored in the device number specified by (s) and later, and store the extracted data in the device number specified by (d) and later.



**Ex.**

When (n)=5



(1) ASCII code (5th character)

- The NULL code (00H) indicating the end of a string is automatically added to the end of the string data.
- When the number of characters in the device specified by (n) is 0, NULL code (00H) is stored in the device specified by (n).

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                         |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) set in the assignment range of the relevant device/label for the device number specified by (s) and later.                                                                                                                                                                                                                              |
| 3285H            | An out-of-range value is set to (s). <ul style="list-style-type: none"> <li>The number of characters of the string in the device specified by (s) exceeds 16383.</li> <li>The number of characters of the string in the device specified by (s) is 0.</li> </ul> The number of characters in the device specify by (n) exceeds that in the device specified by (s). |
| 3286H            | The entire string that was extracted in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored.                                                                                                                                                                                                        |



## Extracting string data from the left

### LEFT(P)

These instructions extract (n) characters of data from the left of the string data, and store the extracted data in the device number specified by (d) and later.

| Ladder               | ST <sup>*1</sup>      |
|----------------------|-----------------------|
|                      | ENO:=LEFTP(EN,s,n,d); |
| FBD/LD <sup>*1</sup> |                       |
|                      |                       |

\*1 The LEFT instruction does not support the ST and FBD/LD. Use the standard function, LEFT.

📖 Page 1373 LEFT(\_E), RIGHT(\_E)

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| LEFT        |                     |
| LEFTP       |                     |

### Setting data

### ■Descriptions, ranges, and data types

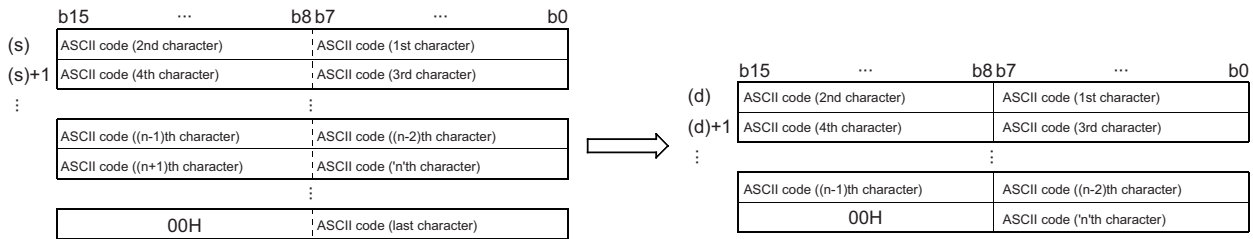
| Operand | Description                                                                                                          | Range      | Data type            | Data type (label) |
|---------|----------------------------------------------------------------------------------------------------------------------|------------|----------------------|-------------------|
| (s)     | Character string or the start device containing the string                                                           | —          | String               | ANYSTRING_SINGLE  |
| (d)     | Start device for storing (n) characters of string extracted from the left of the data in the device specified by (s) | —          | String               | ANYSTRING_SINGLE  |
| (n)     | Number of characters to be extracted                                                                                 | 1 to 16383 | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                                                                  | —          | Bit                  | BOOL              |
| ENO     | Execution result                                                                                                     | —          | Bit                  | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

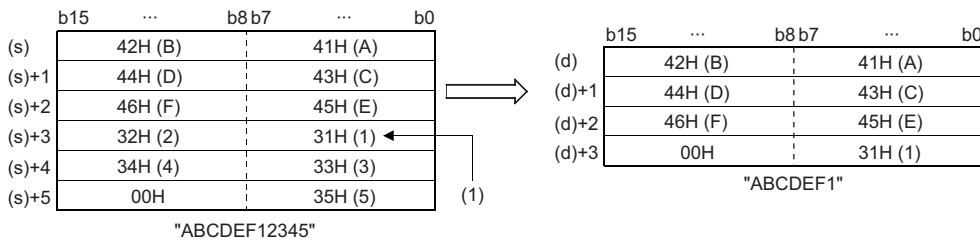
## Processing details

- These instructions extract (n) characters of data from the left of the string data (the start of the string) stored in the device number specified by (s) and later, and store the extracted data in the device number specified by (d) and later.



**Ex.**

When (n)=7



(1) ASCII code (7th character)

- The NULL code (00H) indicating the end of a string is automatically added to the end of the string data.
- When the number of characters in the device specified by (n) is 0, NULL code (00H) is stored in the device specified by (n).

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                         |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) set in the assignment range of the relevant device/label for the device number specified by (s) and later.                                                                                                                                                                                                                              |
| 3285H            | An out-of-range value is set to (s). <ul style="list-style-type: none"> <li>The number of characters of the string in the device specified by (s) exceeds 16383.</li> <li>The number of characters of the string in the device specified by (s) is 0.</li> </ul> The number of characters in the device specify by (n) exceeds that in the device specified by (s). |
| 3286H            | The entire string that was extracted in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored.                                                                                                                                                                                                        |

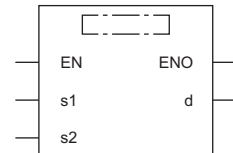
## Extracting the specified string data

### MIDR(P)

These instructions extract data at any position in string data, and store the extracted data in the device number specified by (d) and later.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=MIDR(EN,s1,s2,d); ENO:=MIDRP(EN,s1,s2,d);</pre> |

### FBD/LD



### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| MIDR        |                     |
| MIDRP       |                     |

### Setting data

### Description, range, data type

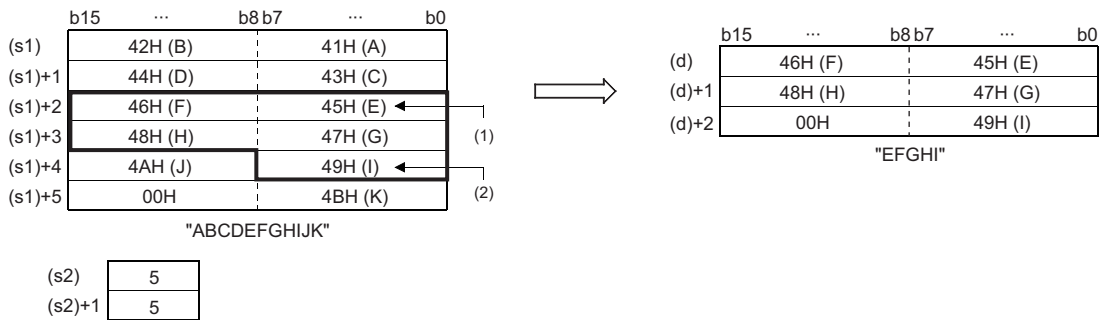
| Operand | Description                                                                                                                                                  | Range | Data type            | Data type (label)                      |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------|----------------------------------------|
| (s1)    | Character string or the start device containing the string                                                                                                   | —     | String               | ANYSTRING_SINGLE                       |
| (d)     | Start device for storing the string data of the operation result                                                                                             | —     | String               | ANYSTRING_SINGLE                       |
| (s2)    | Start device for storing the location of the start character and the number of characters<br>(s2): Location of start character, (s2)+1: Number of characters | —     | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                                                                                                          | —     | Bit                  | BOOL                                   |
| ENO     | Execution result                                                                                                                                             | —     | Bit                  | BOOL                                   |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

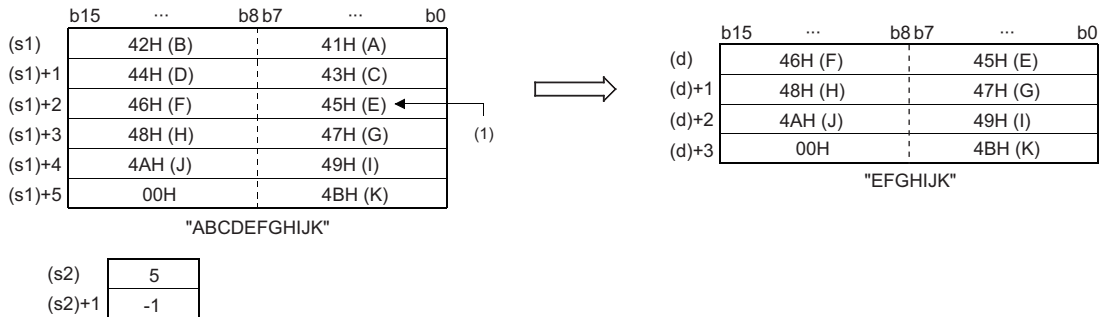
- These instructions extract the data by the number of characters specify by (s2)+1 from the location specified by (s2) in the string data stored in the device number specified by (s1) and later, and store the extracted data in the device number specified by (d) and later.



(1) 5th character position (s2)

(2) ASCII code for 5th character (s2)+1

- The NULL code (00H) indicating the end of a string is automatically added to the end of the string data.
- If the number of characters in the device specified by (s2)+1 is 0, no processing is performed.
- When the number of characters of the data in the device specified by (s2)+1 is -1, the data till the last character data in the device specified by (s1) is stored in the device specified by (d) and later.



(1) 5th character position (s2)

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the assignment range of the relevant device/label for the device number specified by (s1) and later.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 3285H            | <p>The number of characters of the string in the device specified by (s1) exceeds 16383.</p> <p>An out-of-range value is set to (s2).</p> <ul style="list-style-type: none"> <li>The value in the device specified by (s2) is 0 or less.</li> <li>The value in the device specified by (s2)+1 is other than the valid values (-1, 0, 1 or bigger).</li> <li>The value in the device specify by (s2) exceeds the number of characters in the device specified by (s1).</li> <li>The value obtained by adding (s2) and (s2)+1 exceeds the number of characters in the device specified by (s1) plus 1.</li> </ul> |
| 3286H            | The entire string that was extracted in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## Replacing the specified string data

### MIDW(P)

These instructions replace the data at the specified location in the string data with the specified string.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=MIDW(EN,s1,s2,d); ENO:=MIDWP(EN,s1,s2,d);</pre> |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| MIDW        |                     |
| MIDWP       |                     |

### Setting data

### ■Description, range, data type

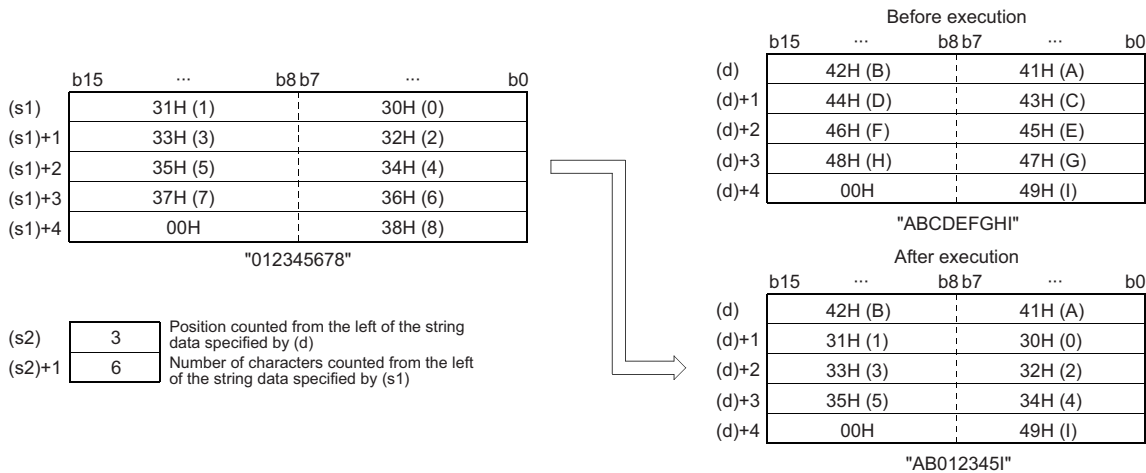
| Operand | Description                                                                                                                                                  | Range | Data type            | Data type (label)                      |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------|----------------------------------------|
| (s1)    | Character string or the start device containing the string                                                                                                   | —     | String               | ANYSTRING_SINGLE                       |
| (d)     | Start device for storing the string data of the operation result                                                                                             | —     | String               | ANYSTRING_SINGLE                       |
| (s2)    | Start device for storing the location of the start character and the number of characters<br>(s2): Location of start character, (s2)+1: Number of characters | —     | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                                                                                                          | —     | Bit                  | BOOL                                   |
| ENO     | Execution result                                                                                                                                             | —     | Bit                  | BOOL                                   |

### ■Applicable devices

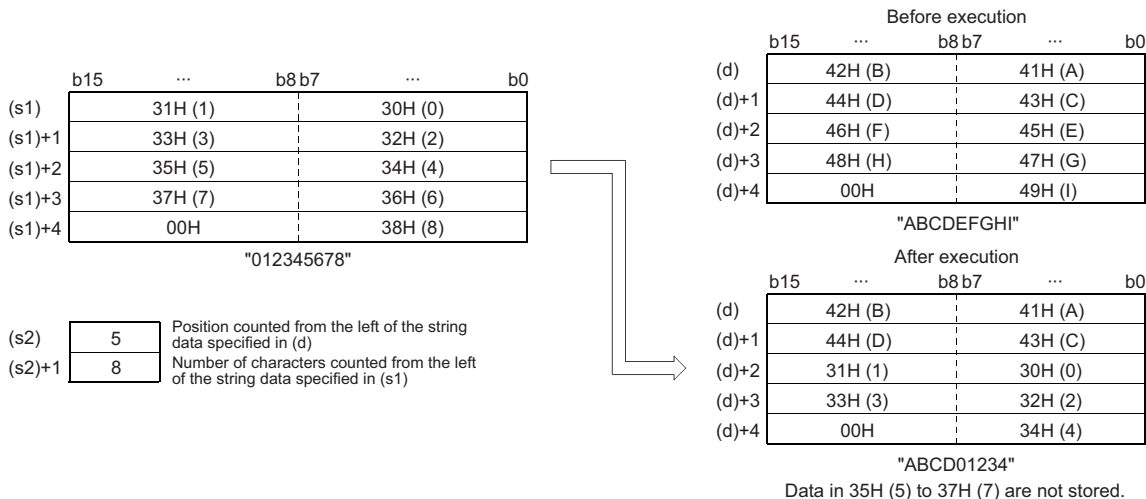
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

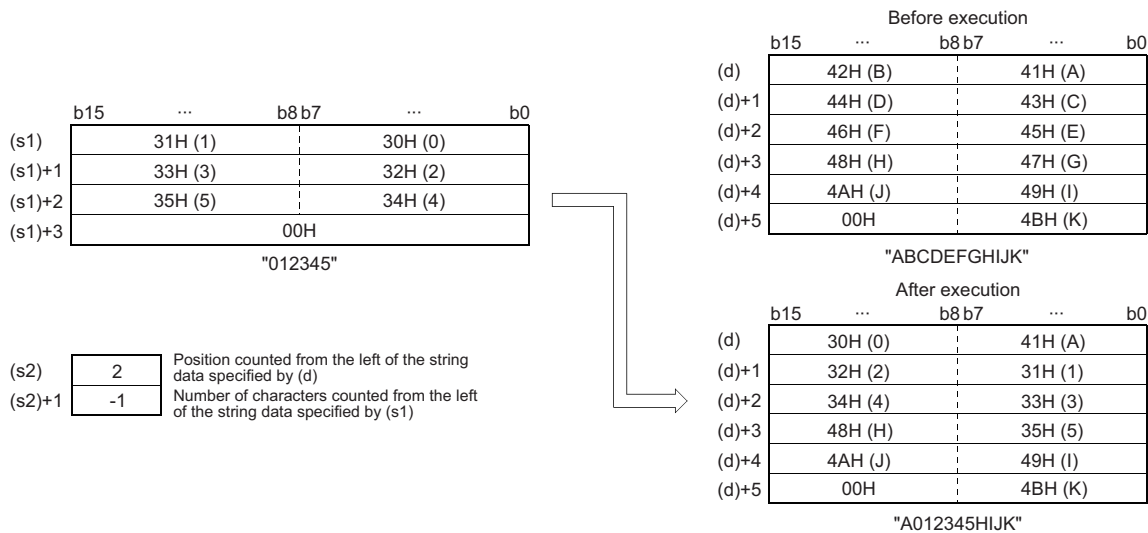
- These instructions read data by the number of characters stored in the device specified by (s2)+1 from the string data stored in the device number specified by (s1) and later, and store the read data at the location in the device specified by (s2) and later in the string stored in the device number specified by (d) and later.



- The NULL code (00H) indicating the end of a string is automatically added to the end of the string data.
- If the number of characters in the device specified by (s2)+1 is 0, no processing is performed.
- If the number of characters in the device specified by (s2)+1 exceeds the last character of the string data in the device specified by (d), the data is stored up to the last character.



- When the number of characters of the data in the device specified by (s2)+1 is -1, the data till the last character data in the device specified by (s1) is stored in the device specified by (d) and later.



## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the assignment range of the relevant device/label for the device number specified by (s1) and later.                                                                                                                                                                                                                                                                                                                        |
|                  | There is no NULL code (00H) in the assignment range of the relevant device/label for the device number specified by (d) and later.                                                                                                                                                                                                                                                                                                                         |
| 3285H            | The number of characters of the string in the device specified by (s1) exceeds 16383.                                                                                                                                                                                                                                                                                                                                                                      |
|                  | The number of characters of the string in the device specified by (d) exceeds 16383.                                                                                                                                                                                                                                                                                                                                                                       |
|                  | An out-of-range value is set to (s2).                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                  | <ul style="list-style-type: none"> <li>The value in the device specified by (s2) is 0 or less.</li> <li>The value in the device specified by (s2)+1 is other than the valid values (-1, 0, 1 or bigger).</li> <li>The value in the device specify by (s2) exceeds the number of characters in the device specified by (d).</li> <li>The value in the device specify by (s2)+1 exceeds the number of characters in the device specified by (s1).</li> </ul> |

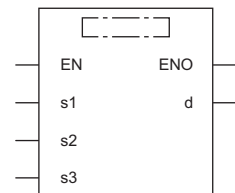
# Searching string data

## INSTR(P)

These instructions search string data for the specified string.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | ENO:=INSTR(EN,s1,s2,s3,d);<br>ENO:=INSTRP(EN,s1,s2,s3,d); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| INSTR       |                     |
| INSTRP      |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                                                      | Range      | Data type            | Data type (label) |
|---------|--------------------------------------------------------------------------------------------------|------------|----------------------|-------------------|
| (s1)    | Character strings to be searched or the start device containing these strings                    | —          | String               | ANYSTRING_SINGLE  |
| (s2)    | Character string to be searched for or the start device containing the string to be searched for | —          | String               | ANYSTRING_SINGLE  |
| (d)     | Device for storing the search result                                                             | —          | 16-bit signed binary | ANY16             |
| (s3)    | Search start position                                                                            | 1 to 16383 | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                                              | —          | Bit                  | BOOL              |
| ENO     | Execution result                                                                                 | —          | Bit                  | BOOL              |

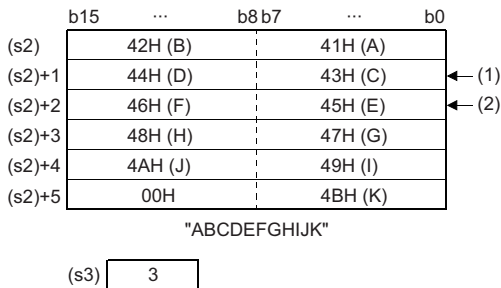
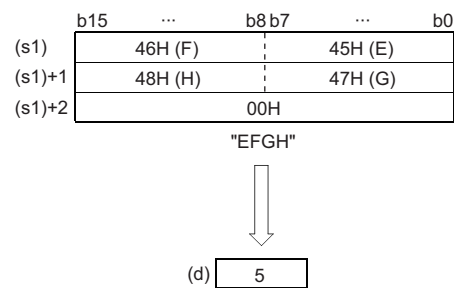
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (s3)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |



## Processing details

- These instructions search the string data stored in the device number specified by (s2) and later starting from the (s3)th character from the left for the string data stored in the device number specified by (s1) and later, and store the search result in the device specified by (d). The search result stored shows the number of characters from the start character of the string data in the device specified by (s2).



- (1) Search start position (s3): 3rd character  
 (2) 5th character from the beginning of the data

- If no string data is matching, 0 is stored in the device specified by (d).

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the assignment range of the relevant device/label for the device specified by (s1) and later.                                                                                                                                           |
|                  | There is no NULL code (00H) in the assignment range of the relevant device/label for the device specified by (s2) and later.                                                                                                                                           |
| 3285H            | An out-of-range value is set to (s1). <ul style="list-style-type: none"> <li>The number of characters of the string that has been set is 0.</li> <li>The number of characters of the string that has been set exceeds 16383.</li> </ul>                                |
|                  | The number of characters of the string that has been set in the device specified by (s2) exceeds 16383.                                                                                                                                                                |
|                  | An out-of-range value is set to (s3). <ul style="list-style-type: none"> <li>The value in the device specify by (s3) exceeds the number of characters in the device specified by (s2).</li> <li>The value in the device specified by (s3) is negative or 0.</li> </ul> |
|                  |                                                                                                                                                                                                                                                                        |

# Inserting string data

## STRINS(P)

These instructions insert the specified string data into the specified position of the string data.

| Ladder | ST                                                            |
|--------|---------------------------------------------------------------|
|        | <pre>ENO:=STRINS(EN,s1,s2,d); ENO:=STRINSP(EN,s1,s2,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| STRINS      |                     |
| STRINSP     |                     |

## Setting data

### Descriptions, ranges, and data types

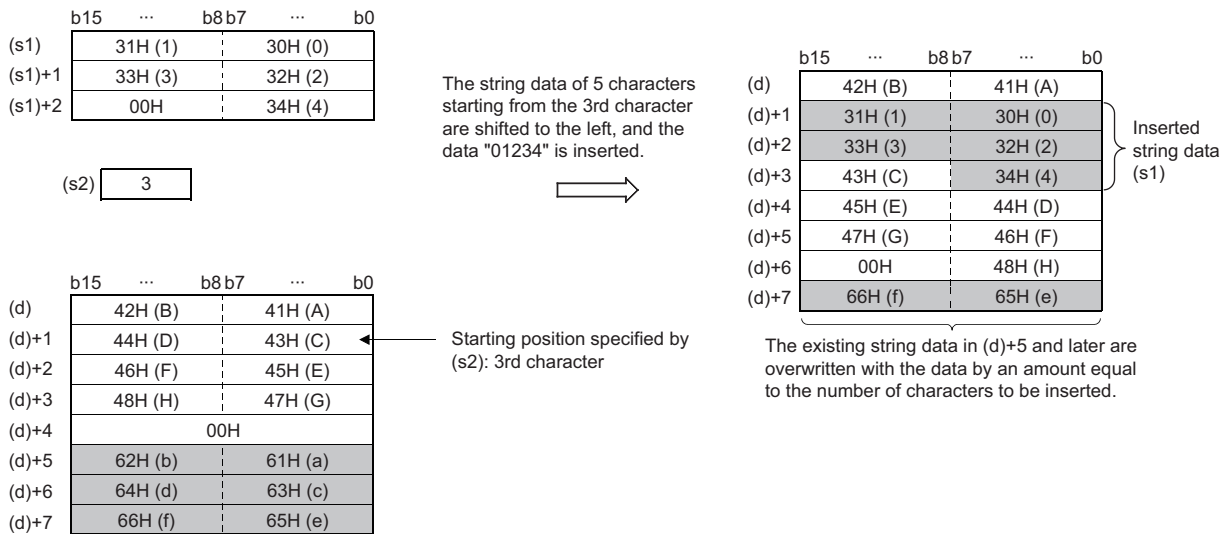
| Operand | Description                                                                              | Range      | Data type            | Data type (label) |
|---------|------------------------------------------------------------------------------------------|------------|----------------------|-------------------|
| (s1)    | Character string to be inserted or the start device containing the string to be inserted | —          | String               | ANYSTRING_SINGLE  |
| (d)     | Start device for storing the insertion result string                                     | —          | String               | ANYSTRING_SINGLE  |
| (s2)    | Insertion position (bytes)                                                               | 1 to 16383 | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                                      | —          | Bit                  | BOOL              |
| ENO     | Execution result                                                                         | —          | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions insert the string data in the device specified by (s1) to the (s2)th character (insertion position) from the start of the string data in the device specified by (d).



- If the string after insertion in the device specified by (s1)+(d) is even, the NULL code (00H) is stored in the device (1 word) next to the last one containing the string.
- If the string after insertion in the device specified by (s1)+(d) is odd, the NULL code (00H) is stored in the last device (upper 8 bits) of the string.
- When the number of characters in the device specified by (d) plus 1 is specified in (s2), the string in the device specified by (s1) is concatenated to the end of the string in the device specified by (d).

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the assignment range of the relevant device/label for the device specified by (s1) and later.<br>There is no NULL code (00H) in the assignment range of the relevant device/label for the device specified by (d) and later.                                                                                                                                                                                                                 |
| 2821H            | The devices specified by (s1) and (d), both containing strings, are overlapping even partly.<br>The device specified by (s1)+(d) containing the string after insertion overlaps with the string storage device specified by (s1).                                                                                                                                                                                                                                           |
| 3285H            | The number of characters of the string in the device specified by (s1) exceeds 16383.<br>An out-of-range value is set to (s2). <ul style="list-style-type: none"> <li>The specified value exceeds the number of characters plus 1 of the string in the device specified by (d).</li> <li>The specified value is not within the following range.</li> </ul> $1 \leq (s2) \leq 16383$<br>The number of characters of the string in the device specified by (d) exceeds 16383. |
| 3286H            | The string after insertion stored in the device specified by (s1)+(d) becomes data outside the output enable range. <ul style="list-style-type: none"> <li>The number of characters of the string after insertion exceeds 16383.</li> <li>The entire string after insertion in the assignment range of the relevant device/label for the device number specified by (d) and later cannot be stored.</li> </ul>                                                              |

# Deleting string data

## STRDEL(P)

These instructions delete (n) characters starting from the specified position of string data.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | ENO:=STRDEL(EN,s,n,d);<br>ENO:=STRDELP(EN,s,n,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| STRDEL      |                     |
| STRDELP     |                     |

## Setting data

### Descriptions, ranges, and data types

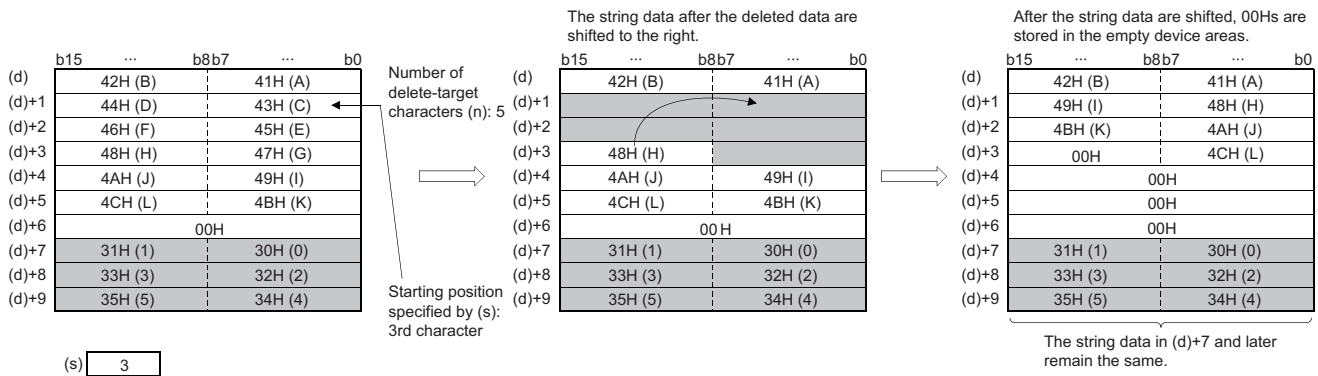
| Operand | Description                                      | Range          | Data type            | Data type (label) |
|---------|--------------------------------------------------|----------------|----------------------|-------------------|
| (d)     | Start device containing the string to be deleted | —              | String               | ANYSTRING_SINGLE  |
| (s)     | Deletion start position                          | 1 to 16383     | 16-bit signed binary | ANY16             |
| (n)     | Number of characters to be deleted               | 0 to 16384-(s) | 16-bit signed binary | ANY16             |
| EN      | Execution condition                              | —              | Bit                  | BOOL              |
| ENO     | Execution result                                 | —              | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s)     | —                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (n)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions delete (n) characters starting from the position (deletion start position) specified by the (s)th character from the start of the string data in the device specified by (d).



- If the string after deletion in the device specified by (d) is even, the NULL code (00H) is stored in the device (1 word) next to the last one containing the string.
- If the string after deletion in the device specified by (d) is odd, the NULL code (00H) is stored in the last device (upper 8 bits) of the string.
- The string following the deleted one is shifted by (n) characters to the right, and the NULL code (00H) is stored in the device that has been emptied.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the assignment range of the relevant device/label for the device specified by (d) and later.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 3285H            | <p>The number of characters of the string in the device specified by (d) exceeds 16383.</p> <p>An out-of-range value is set to (s).</p> <ul style="list-style-type: none"> <li>The specified value is not within the following range.<br/> <math>1 \leq (s) \leq 16383</math></li> <li>The specified value exceeds the number of characters of the string in the device specified by (d).</li> </ul> <p>An out-of-range value is set to (n).</p> <ul style="list-style-type: none"> <li>The specified value exceeds the number of characters from the data in the device specified by (s) of the string in the device specified by (d) to the last character.</li> <li>The specified value is negative.</li> </ul> |

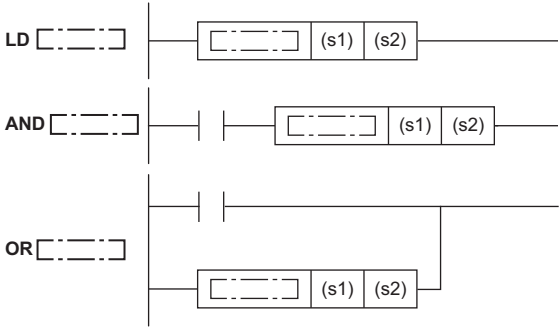
# 17 REAL VALUE PROCESSING

## 17.1 Floating-point Instruction

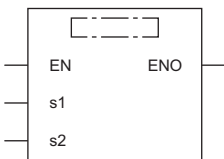
### Comparing single-precision real numbers

#### LDE□, ANDE□, ORE□

These instructions perform a comparison operation of a single-precision real number. (Devices are used as a normally open contact.)

| Ladder                                                                                                                                                   | ST                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>(□ is replaced by E=, E&lt;&gt;, E&gt;, E&lt;=, E&lt;, E&gt;=.)</p> | <pre>ENO:=LDE_□(EN,s1,s2); ENO:=ANDE_□(EN,s1,s2); ENO:=ORE_□(EN,s1,s2);</pre> <p>(□ is replaced by any of the following: EQ, NE, GT, LE, LT, GE.)*1</p> |

#### FBD/LD



(□ is replaced by a combination of LDE\_, ANDE\_, or ORE\_ and EQ, NE, GT, LE, LT, or GE.)\*1

\*1 EQ indicates =, NE indicates <>, GT indicates >, LE indicates <=, LT indicates <, and GE indicates >=.

#### ■Execution condition

| Instruction       | Execution condition |
|-------------------|---------------------|
| LDE□, ANDE□, ORE□ | Every scan          |

#### Setting data

#### ■Description, range, data type

| Operand | Description                                                             | Range                               | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------|-------------------------------------|------------------------------|-------------------|
| (s1)    | Comparison data or the start device where the comparison data is stored | $0, 2^{-126} \leq  (s1)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (s2)    | Comparison data or the start device where the comparison data is stored | $0, 2^{-126} \leq  (s2)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                     | —                                   | Bit                          | BOOL              |
| ENO     | Execution result                                                        | —                                   | Bit                          | BOOL              |

## ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |

## Processing details

- These instructions perform a comparison operation between the single-precision real number in the device specified by (s1) and the single-precision real number in the device specified by (s2). (Devices are used as a normally open contact.)
- The following table lists the comparison operation results of each instruction.

| Instruction symbol (ladder, FBD/LD) | Condition | Result                             |
|-------------------------------------|-----------|------------------------------------|
| E=, EQ                              | (s1)=(s2) | Continuity state (ENO is on.)      |
| E<>, NE                             | (s1)≠(s2) |                                    |
| E>, GT                              | (s1)>(s2) |                                    |
| E<=, LE                             | (s1)≤(s2) |                                    |
| E<, LT                              | (s1)<(s2) |                                    |
| E>=, GE                             | (s1)≥(s2) |                                    |
| E=, EQ                              | (s1)≠(s2) | Non-continuity state (ENO is off.) |
| E<>, NE                             | (s1)=(s2) |                                    |
| E>, GT                              | (s1)≤(s2) |                                    |
| E<=, LE                             | (s1)>(s2) |                                    |
| E<, LT                              | (s1)≥(s2) |                                    |
| E>=, GE                             | (s1)<(s2) |                                    |

- If the data in the device specified by (s1) or (s2) is out of the range of setting data, the operation result will be non-continuity (ENO OFF).
- If the LDE\_□ instruction is used in the program written in FBD/LD, use a left rail or a variable/constant which is always on for EN.
- If the ORE\_□ instruction is used in the program written in FBD/LD and EN is set to TRUE, ENO turns on. EN will not be an execution condition.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

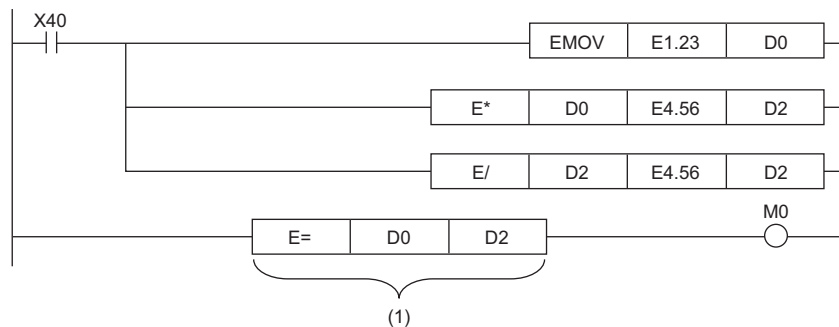
📖 Page 40 Precautions

## Operation error

There is no operation error.

### Point

Note that two values may not be equal due to an error when the E= instruction is used.



(1) Two values may not be equal.

# Comparing double-precision real numbers

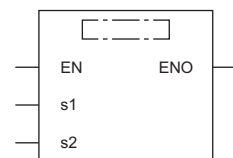
## LDED□, ANDED□, ORED□

These instructions perform a comparison operation of a double-precision real number. (Devices are used as a normally open contact.)

| Ladder   | ST                                                                                                                                                    |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br><br> | <pre> ENO:=LDED_□(EN,s1,s2); ENO:=ANDED_□(EN,s1,s2); ENO:=ORED_□(EN,s1,s2); (□ is replaced by any of the following: EQ, NE, GT, LE, LT, GE.)*1 </pre> |

(□ is replaced by ED=, ED<>, ED>, ED<=, ED<, ED>=.)

## FBD/LD



(□ is replaced by a combination of LDED\_, ANDED\_, or ORED\_ and EQ, NE, GT, LE, LT, or GE.)\*1

\*1 EQ indicates =, NE indicates <>, GT indicates >, LE indicates <=, LT indicates <, and GE indicates >=.

## Execution condition

| Instruction          | Execution condition |
|----------------------|---------------------|
| LDED□, ANDED□, ORED□ | Every scan          |

## Setting data

## Description, range, data type

| Operand | Description                                                             | Range                                 | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------|---------------------------------------|------------------------------|-------------------|
| (s1)    | Comparison data or the start device where the comparison data is stored | $0, 2^{-1022} \leq  (s1)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (s2)    | Comparison data or the start device where the comparison data is stored | $0, 2^{-1022} \leq  (s2)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                     | —                                     | Bit                          | BOOL              |
| ENO     | Execution result                                                        | —                                     | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —    | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |



## Processing details

- These instructions perform a comparison operation between the double-precision real number in the device specified by (s1) and the double-precision real number in the device specified by (s2). (Devices are used as a normally open contact.)
- The following table lists the comparison operation results of each instruction.

| Instruction symbol (ladder, FBD/LD) | Condition | Result                             |
|-------------------------------------|-----------|------------------------------------|
| ED=, EQ                             | (s1)=(s2) | Continuity state (ENO is on.)      |
| ED<>, NE                            | (s1)≠(s2) |                                    |
| ED>, GT                             | (s1)>(s2) |                                    |
| ED<=, LE                            | (s1)≤(s2) |                                    |
| ED<, LT                             | (s1)<(s2) |                                    |
| ED>=, GE                            | (s1)≥(s2) |                                    |
| ED=, EQ                             | (s1)≠(s2) | Non-continuity state (ENO is off.) |
| ED<>, NE                            | (s1)=(s2) |                                    |
| ED>, GT                             | (s1)≤(s2) |                                    |
| ED<=, LE                            | (s1)>(s2) |                                    |
| ED<, LT                             | (s1)≥(s2) |                                    |
| ED>=, GE                            | (s1)<(s2) |                                    |

- If the data in the device specified by (s1) or (s2) is out of the range of setting data, the operation result will be non-continuity (ENO OFF).
- If the LDED\_□ instruction is used in the program written in FBD/LD, use a left rail or a variable/constant which is always on for EN.
- If the ORED\_□ instruction is used in the program written in FBD/LD and EN is set to TRUE, ENO turns on. EN will not be an execution condition.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

 Page 40 Precautions

## Operation error

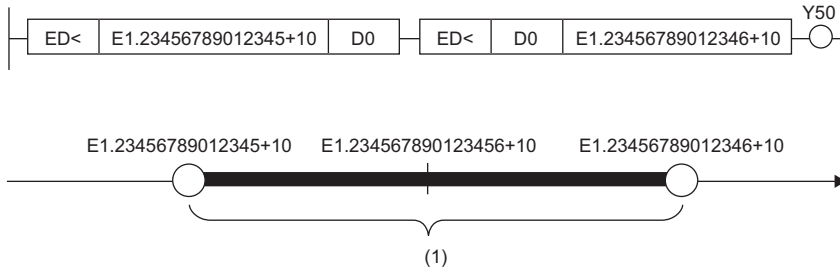
There is no operation error.

## Precautions

The maximum number of digits of a real number which can be input using the engineering tool is 15, and therefore these instructions cannot perform comparison with a real number consisting of 16 or more effective digits. When these instructions are used to determine the match or mismatch with a real number consisting of 16 or more effective digits, the instructions need to compare the size with the approximate values before and after the real number to be compared.

**Ex.**

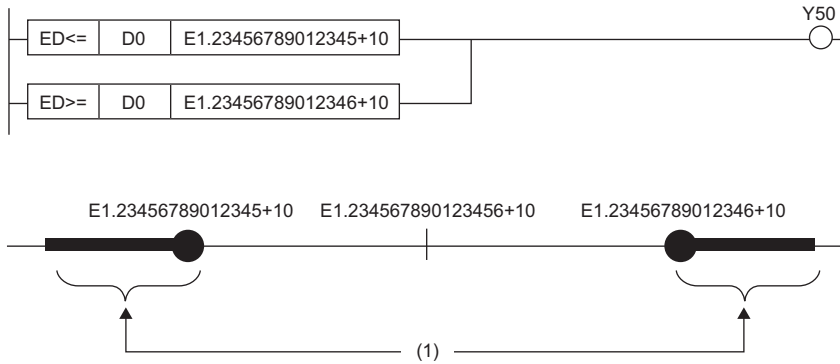
To determine the match between E1.234567890123456+10 (16 effective digits) and a double-precision real number



(1) Whether data in D0 to D3 are within this range is checked. (The boundary values are not included.)

**Ex.**

To determine the mismatch between E1.234567890123456+10 (16 effective digits) and a double-precision real number



(1) Whether data in D0 to D3 are within this range is checked. (The boundary values are included.)

# Adding single-precision real numbers

## E+(P) [when two operands are set]

These instructions add single-precision real numbers.

| Ladder                                                            | ST                                                                |
|-------------------------------------------------------------------|-------------------------------------------------------------------|
|                                                                   | Not supported<br>(  Page 819 E+(P) [when three operands are set]) |
| FBD/LD                                                            |                                                                   |
| Not supported<br>(  Page 819 E+(P) [when three operands are set]) |                                                                   |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| E+          |                     |
| E+P         |                     |

### Setting data

### Description, range, data type

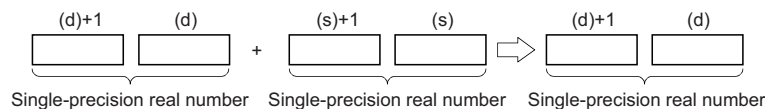
| Operand | Description                                                                   | Range                              | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Second addend data or the start device where the second addend data is stored | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device where the first addend data is stored                            | $0, 2^{-126} \leq  (d)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |

### Applicable devices

| Operand | Bit                              |      | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions add the single-precision real number in the device specified by (s) to the single-precision real number in the device specified by (d), and store the result in the device specified by (d).



- Value  $0$  or  $2^{-126} \leq |\text{specified value (stored value)}| < 2^{128}$  can be specified or stored in the devices specified by (s) and (d).
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

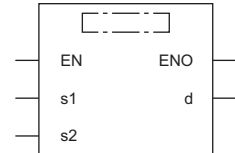
| Error code (SD0) | Description                                                                                                             |
|------------------|-------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                  |
|                  | The value input to (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                  |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ {(d)}  < 2^{128}$ |

## E+(P) [when three operands are set]

These instructions add single-precision real numbers.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | ENO:=EPLUS(EN,s1,s2,d);<br>ENO:=EPLUSP(EN,s1,s2,d); |

### FBD/LD



(□) is replaced by either of the following: EPLUS, EPLUSP.)

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| E+          |                     |
| E+P         |                     |

### Setting data

### Description, range, data type

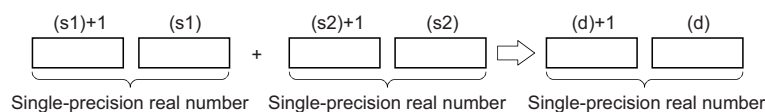
| Operand | Description                                                                   | Range                               | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------------|-------------------------------------|------------------------------|-------------------|
| (s1)    | First addend data or the start device where the first addend data is stored   | $0, 2^{-126} \leq  (s1)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (s2)    | Second addend data or the start device where the second addend data is stored | $0, 2^{-126} \leq  (s2)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                 | —                                   | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                           | —                                   | Bit                          | BOOL              |
| ENO     | Execution result                                                              | —                                   | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions add the single-precision real number in the device specified by (s2) to the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).



- Value  $0$  or  $2^{-126} \leq |\text{specified value (stored value)}| < 2^{128}$  can be specified or stored in the devices specified by (s1), (s2), and (d).

## Operation error

| Error code (SD0) | Description                                                                                                             |
|------------------|-------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                 |
|                  | The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                 |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ {(d)}  < 2^{128}$ |

# Subtracting single-precision real numbers

## E-(P) [when two operands are set]

These instructions perform subtraction between single-precision real numbers.

| Ladder                                                            | ST                                                                |
|-------------------------------------------------------------------|-------------------------------------------------------------------|
|                                                                   | Not supported<br>(  Page 823 E-(P) [when three operands are set]) |
| FBD/LD                                                            |                                                                   |
| Not supported<br>(  Page 823 E-(P) [when three operands are set]) |                                                                   |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| E-          |                     |
| E-P         |                     |

### Setting data

### Description, range, data type

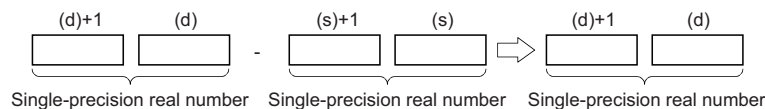
| Operand | Description                                                         | Range                              | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Subtrahend data or the start device where subtrahend data is stored | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device where minuend data is stored                           | $0, 2^{-126} \leq  (d)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions subtract the single-precision real number in the device specified by (s) from the single-precision real number in the device specified by (d), and store the result in the device specified by (d).



- Value  $0$  or  $2^{-126} \leq |\text{specified value (stored value)}| < 2^{128}$  can be specified or stored in the devices specified by (s) and (d).
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                             |
|------------------|-------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                  |
|                  | The value input to (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                  |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ {(d)}  < 2^{128}$ |

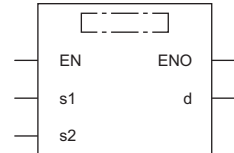


## E-(P) [when three operands are set]

These instructions perform subtraction between single-precision real numbers.

| Ladder | ST                                                    |
|--------|-------------------------------------------------------|
|        | ENO:=EMINUS(EN,s1,s2,d);<br>ENO:=EMINUSP(EN,s1,s2,d); |

### FBD/LD



(□ is replaced by either of the following: EMINUS, EMINUSP.)

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| E-          |                     |
| E-P         |                     |

### Setting data

### ■Description, range, data type

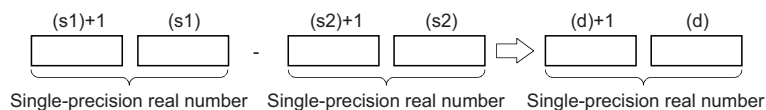
| Operand | Description                                                         | Range                               | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------|-------------------------------------|------------------------------|-------------------|
| (s1)    | Minuend data or the start device where minuend data is stored       | $0, 2^{-126} \leq  (s1)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (s2)    | Subtrahend data or the start device where subtrahend data is stored | $0, 2^{-126} \leq  (s2)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                       | —                                   | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                 | —                                   | Bit                          | BOOL              |
| ENO     | Execution result                                                    | —                                   | Bit                          | BOOL              |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions subtract the single-precision real number in the device specified by (s2) from the single-precision real number in the device specified by (s1), and store the result in the device specified by (d).



- Value 0 or  $2^{-126} \leq |\text{specified value (stored value)}| < 2^{128}$  can be specified or stored in the devices specified by (s1), (s2), and (d).
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

| Error code<br>(SD0) | Description                                                                                                                  |
|---------------------|------------------------------------------------------------------------------------------------------------------------------|
| 3282H               | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                      |
|                     | The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                      |
| 3283H               | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{128}$ |

# Adding double-precision real numbers

## ED+(P) [when two operands are set]

These instructions add double-precision real numbers.

| Ladder                                                            | ST                                                                |
|-------------------------------------------------------------------|-------------------------------------------------------------------|
|                                                                   | Not supported<br>( Page 827 ED+(P) [when three operands are set]) |
| FBD/LD                                                            |                                                                   |
| Not supported<br>( Page 827 ED+(P) [when three operands are set]) |                                                                   |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ED+         |                     |
| ED+P        |                     |

## Setting data

## Description, range, data type

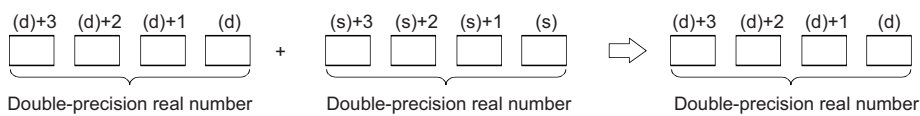
| Operand | Description                                                                   | Range                                | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Second addend data or the start device where the second addend data is stored | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device where the first addend data is stored                            | $0, 2^{-1022} \leq  (d)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |

## Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —         | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —         | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions add the double-precision real number in the device specified by (d) to the double-precision real number in the device specified by (s), and store the result in the device specified by (d).



- Value  $0$  or  $2^{-1022} \leq |\text{specified value (stored value)}| < 2^{1024}$  can be specified or stored in the devices specified by (s) and (d).
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

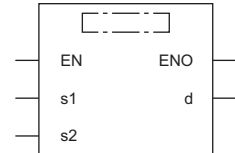
| Error code (SD0) | Description                                                                                                              |
|------------------|--------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                   |
|                  | The value input to (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                   |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ {(d)}  < 2^{1024}$ |

## ED+(P) [when three operands are set]

These instructions add double-precision real numbers.

| Ladder | ST                                                    |
|--------|-------------------------------------------------------|
|        | ENO:=EDPLUS(EN,s1,s2,d);<br>ENO:=EDPLUSP(EN,s1,s2,d); |

### FBD/LD



(□ is replaced by either of the following: EDPLUS, EDPLUSP.)

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ED+         |                     |
| ED+P        |                     |

### Setting data

### ■Description, range, data type

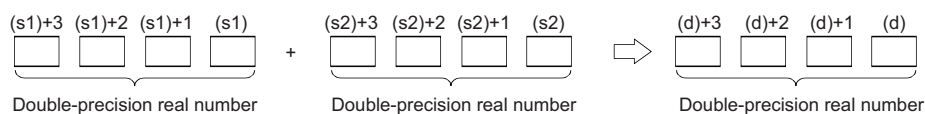
| Operand | Description                                                                   | Range                                 | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------------|---------------------------------------|------------------------------|-------------------|
| (s1)    | First addend data or the start device where the first addend data is stored   | $0, 2^{-1022} \leq  (s1)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (s2)    | Second addend data or the start device where the second addend data is stored | $0, 2^{-1022} \leq  (s2)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                 | —                                     | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                           | —                                     | Bit                          | BOOL              |
| ENO     | Execution result                                                              | —                                     | Bit                          | BOOL              |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions add the double-precision real number in the device specified by (s1) to the double-precision real number in the device specified by (s2), and store the result in the device specified by (d).



- Value 0 or  $2^{-1022} \leq |\text{specified value (stored value)}| < 2^{1024}$  can be specified or stored in the devices specified by (s1), (s2), and (d).
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                |
|                  | The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ (d)  < 2^{1024}$ |

# Subtracting double-precision real numbers

## ED-(P) [when two operands are set]

These instructions perform subtraction between double-precision real numbers.

| Ladder                                                             | ST                                                                 |
|--------------------------------------------------------------------|--------------------------------------------------------------------|
|                                                                    | Not supported<br>(  Page 831 ED-(P) [when three operands are set]) |
| FBD/LD                                                             |                                                                    |
| Not supported<br>(  Page 831 ED-(P) [when three operands are set]) |                                                                    |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ED-         |                     |
| ED-P        |                     |

## Setting data

## Description, range, data type

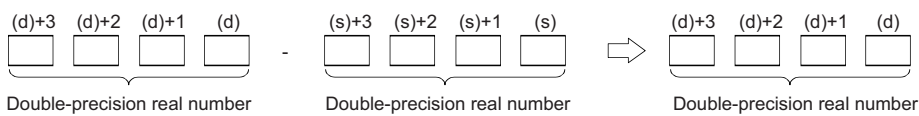
| Operand | Description                                                         | Range                                | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Subtrahend data or the start device where subtrahend data is stored | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device where minuend data is stored                           | $0, 2^{-1022} \leq  (d)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |

## Applicable devices

| Operand | Bit                              |      | Word                                  |            | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —          | —           | ○           | —                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —          | —           | ○           | —                      | ○        | — | —  | —      |

## Processing details

- These instructions subtract the double-precision real number in the device specified by (s) from the double-precision real number in the device specified by (d), and store the result in the device specified by (d).



- Value  $0$  or  $2^{-1022} \leq |\text{specified value (stored value)}| < 2^{1024}$  can be specified or stored in the devices specified by (s) and (d).
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                              |
|------------------|--------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                   |
|                  | The value input to (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                   |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ {(d)}  < 2^{1024}$ |

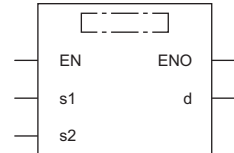


## ED-(P) [when three operands are set]

These instructions perform subtraction between double-precision real numbers.

| Ladder | ST                                                      |
|--------|---------------------------------------------------------|
|        | ENO:=EDMINUS(EN,s1,s2,d);<br>ENO:=EDMINUSP(EN,s1,s2,d); |

### FBD/LD



(□ is replaced by either of the following: EDMINUS, EDMINUSP.)

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ED-         |                     |
| ED-P        |                     |

### Setting data

### Description, range, data type

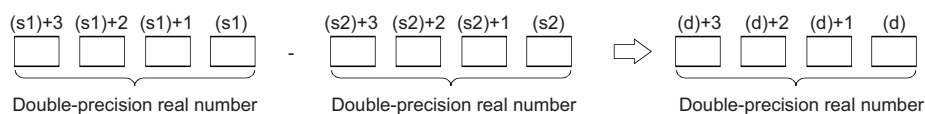
| Operand | Description                                                         | Range                                 | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------|---------------------------------------|------------------------------|-------------------|
| (s1)    | Minuend data or the start device where minuend data is stored       | $0, 2^{-1022} \leq  (s1)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (s2)    | Subtrahend data or the start device where subtrahend data is stored | $0, 2^{-1022} \leq  (s2)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                       | —                                     | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                 | —                                     | Bit                          | BOOL              |
| ENO     | Execution result                                                    | —                                     | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions subtract the double-precision real number in the device specified by (s2) from the double-precision real number in the device specified by (s1), and store the result in the device specified by (d).



- Value 0 or  $2^{-1022} \leq |\text{specified value (stored value)}| < 2^{1024}$  can be specified or stored in the devices specified by (s1), (s2), and (d).
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                |
|                  | The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ (d)  < 2^{1024}$ |

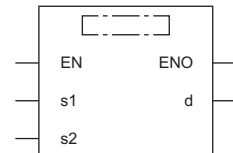
# Multiplying single-precision real numbers

## E\*(P)

These instructions multiply single-precision real numbers.

| Ladder | ST                                                            |
|--------|---------------------------------------------------------------|
|        | <pre>ENO:=EMULTI(EN,s1,s2,d); ENO:=EMULTIP(EN,s1,s2,d);</pre> |

## FBD/LD



(□ is replaced by either of the following: EMULTI, EMULTIP.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| E*          |                     |
| E*P         |                     |

## Setting data

## Description, range, data type

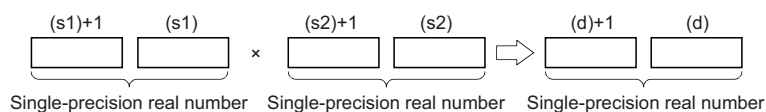
| Operand | Description                                                             | Range                               | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------|-------------------------------------|------------------------------|-------------------|
| (s1)    | Multiplicand data or the start device where multiplicand data is stored | $0, 2^{-126} \leq  (s1)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (s2)    | Multiplier data or the start device where multiplier data is stored     | $0, 2^{-126} \leq  (s2)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                           | —                                   | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                     | —                                   | Bit                          | BOOL              |
| ENO     | Execution result                                                        | —                                   | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions multiply the single-precision real number in the device specified by (s1) by the single-precision real number in the device specified by (s2), and store the multiplication result in the device specified by (d).



- Value 0 or  $2^{-126} \leq |\text{specified value (stored value)}| < 2^{128}$  can be specified or stored in the devices specified by (s1), (s2), and (d).
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

 Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                                  |
|------------------|------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                      |
|                  | The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                      |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{128}$ |

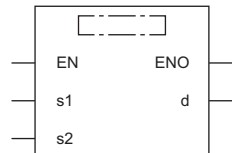
# Dividing single-precision real numbers

## E/(P)

These instructions perform division between single-precision real numbers.

| Ladder | ST                                                                  |
|--------|---------------------------------------------------------------------|
|        | <pre>ENO:=EDIVISION(EN,s1,s2,d); ENO:=EDIVISIONP(EN,s1,s2,d);</pre> |

## FBD/LD



(□ is replaced by either of the following: EDIVISION, EDIVISIONP.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| E/          |                     |
| E/P         |                     |

## Setting data

## Description, range, data type

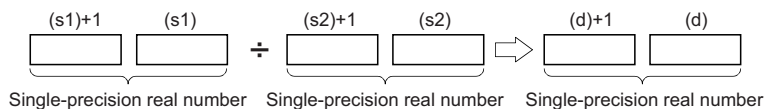
| Operand | Description                                                     | Range                               | Data type                    | Data type (label) |
|---------|-----------------------------------------------------------------|-------------------------------------|------------------------------|-------------------|
| (s1)    | Dividend data or the start device where dividend data is stored | $0, 2^{-126} \leq  (s1)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (s2)    | Divisor data or the start device where divisor data is stored   | $0, 2^{-126} \leq  (s2)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                   | —                                   | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                             | —                                   | Bit                          | BOOL              |
| ENO     | Execution result                                                | —                                   | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions divide the single-precision real number in the device specified by (s1) by the single-precision real number in the device specified by (s2), and store the division result in the device specified by (d).



- Value 0 or  $2^{-126} \leq |\text{specified value (stored value)}| < 2^{128}$  can be specified or stored in the devices specified by (s1), (s2), and (d).
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                                  |
|------------------|------------------------------------------------------------------------------------------------------------------------------|
| 3280H            | The data (divisor) in the device specified by (s2) is 0.                                                                     |
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                      |
|                  | The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                      |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{128}$ |

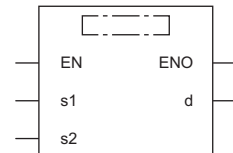
# Multiplying double-precision real numbers

## ED\*(P)

These instructions multiply double-precision real numbers.

| Ladder | ST                                                              |
|--------|-----------------------------------------------------------------|
|        | <pre>ENO:=EDMULTI(EN,s1,s2,d); ENO:=EDMULTIP(EN,s1,s2,d);</pre> |

## FBD/LD



(□ is replaced by either of the following: EDMULTI, EDMULTIP.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ED*         |                     |
| ED*P        |                     |

## Setting data

## Description, range, data type

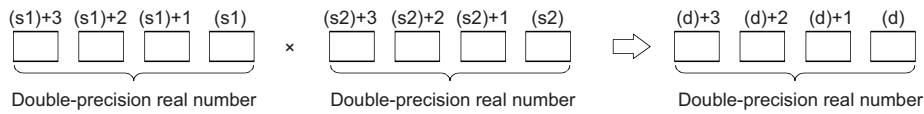
| Operand | Description                                                             | Range                                 | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------|---------------------------------------|------------------------------|-------------------|
| (s1)    | Multiplicand data or the start device where multiplicand data is stored | $0, 2^{-1022} \leq  (s1)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (s2)    | Multiplier data or the start device where multiplier data is stored     | $0, 2^{-1022} \leq  (s2)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                           | —                                     | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                     | —                                     | Bit                          | BOOL              |
| ENO     | Execution result                                                        | —                                     | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions multiply the double-precision real number in the device specified by (s1) by the double-precision real number in the device specified by (s2), and store the multiplication result in the device specified by (d).



- Value 0 or  $2^{-1022} \leq |\text{specified value (stored value)}| < 2^{1024}$  can be specified or stored in the devices specified by (s1), (s2), and (d).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                             |
|------------------|---------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                 |
|                  | The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                 |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (d)  < 2^{1024}$ |



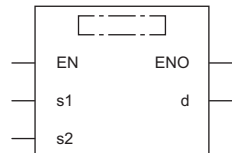
# Dividing double-precision real numbers

## ED/(P)

These instructions perform division between double-precision real numbers.

| Ladder | ST                                                                    |
|--------|-----------------------------------------------------------------------|
|        | <pre>ENO:=EDDIVISION(EN,s1,s2,d); ENO:=EDDIVISIONP(EN,s1,s2,d);</pre> |

## FBD/LD



(□ is replaced by either of the following: EDDIVISION, EDDIVISIONP.)

## ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ED/         |                     |
| ED/P        |                     |

## Setting data

## ■Description, range, data type

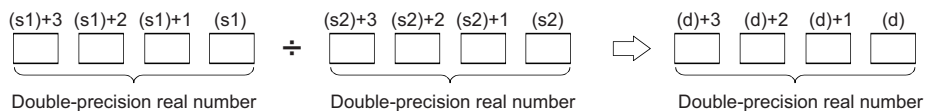
| Operand | Description                                                     | Range                                 | Data type                    | Data type (label) |
|---------|-----------------------------------------------------------------|---------------------------------------|------------------------------|-------------------|
| (s1)    | Dividend data or the start device where dividend data is stored | $0, 2^{-1022} \leq  (s1)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (s2)    | Divisor data or the start device where divisor data is stored   | $0, 2^{-1022} \leq  (s2)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                   | —                                     | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                             | —                                     | Bit                          | BOOL              |
| ENO     | Execution result                                                | —                                     | Bit                          | BOOL              |

## ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions divide the double-precision real number in the device specified by (s1) by the double-precision real number in the device specified by (s2), and store the division result in the device specified by (d).



- Value 0 or  $2^{-1022} \leq |\text{specified value (stored value)}| < 2^{1024}$  can be specified or stored in the devices specified by (s1), (s2), and (d).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------|
| 3280H            | The data (divisor) in the device specified by (s2) is 0.                                                               |
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                |
|                  | The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ (d)  < 2^{1024}$ |

# Converting 16-bit signed binary data to single-precision real number

## INT2FLT(P)

These instructions convert 16-bit signed binary data to a single-precision real number.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | ENO:=INT2FLT(EN,s,d);<br>ENO:=INT2FLTP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| INT2FLT     |                     |
| INT2FLTP    |                     |

### Setting data

### Description, range, data type

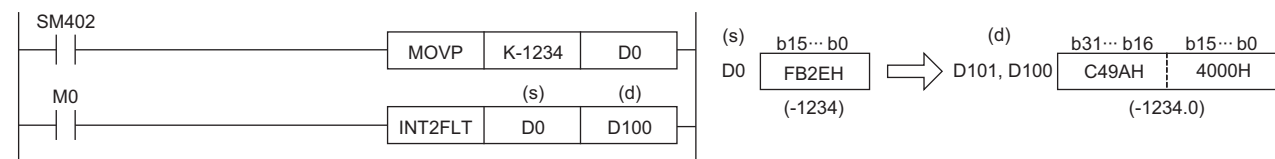
| Operand | Description                                                                                             | Range           | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------------|-----------------|------------------------------|-------------------|
| (s)     | Integral data to be converted to a single-precision real number, or the device containing integral data | -32768 to 32767 | 16-bit signed binary         | ANY16_S           |
| (d)     | Start device for storing the converted single-precision real number                                     | —               | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                                     | —               | Bit                          | BOOL              |
| ENO     | Execution result                                                                                        | —               | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

These instructions convert the 16-bit signed binary data in the device specified by (s) to a single-precision real number, and store the converted data in the device specified by (d).



### Operation error

There is no operation error.

# Converting 16-bit unsigned binary data to single-precision real number

## UINT2FLT(P)

These instructions convert 16-bit unsigned binary data to a single-precision real number.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | ENO:=UINT2FLT(EN,s,d);<br>ENO:=UINT2FLTP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| UINT2FLT    |                     |
| UINT2FLTP   |                     |

### Setting data

### Description, range, data type

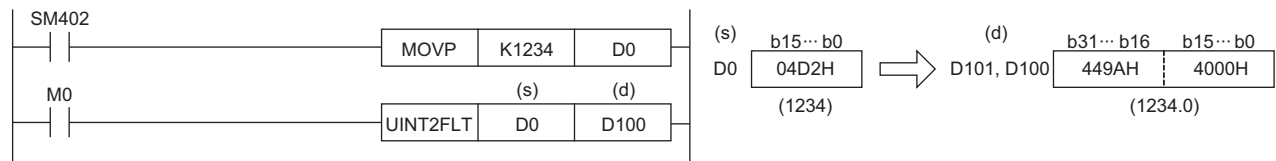
| Operand | Description                                                                                             | Range      | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------------|------------|------------------------------|-------------------|
| (s)     | Integral data to be converted to a single-precision real number, or the device containing integral data | 0 to 65535 | 16-bit unsigned binary       | ANY16_U           |
| (d)     | Start device for storing the converted single-precision real number                                     | —          | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                                     | —          | Bit                          | BOOL              |
| ENO     | Execution result                                                                                        | —          | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

These instructions convert the 16-bit unsigned binary data in the device specified by (s) to a single-precision real number, and store the real number in the device specified by (d).



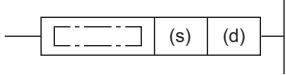
### Operation error

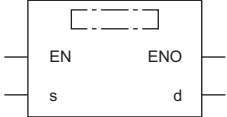
There is no operation error.

# Converting 32-bit signed binary data to single-precision real number

## DINT2FLT(P)

These instructions convert 32-bit signed binary data to a single-precision real number.

| Ladder                                                                            | ST                                                        |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|
|  | <pre>ENO:=DINT2FLT(EN,s,d); ENO:=DINT2FLTP(EN,s,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| DINT2FLT    |  |
| DINT2FLTP   |  |

### Setting data

### Description, range, data type

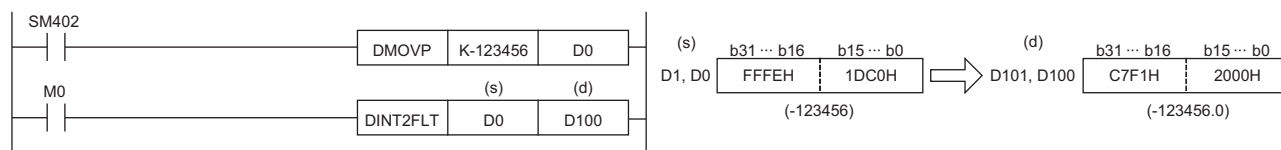
| Operand | Description                                                                                                   | Range                     | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------------------|---------------------------|------------------------------|-------------------|
| (s)     | Integral data to be converted to a single-precision real number, or the start device containing integral data | -2147483648 to 2147483647 | 32-bit signed binary         | ANY32_S           |
| (d)     | Start device for storing the converted single-precision real number                                           | —                         | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                                           | —                         | Bit                          | BOOL              |
| ENO     | Execution result                                                                                              | —                         | Bit                          | BOOL              |

### Applicable devices

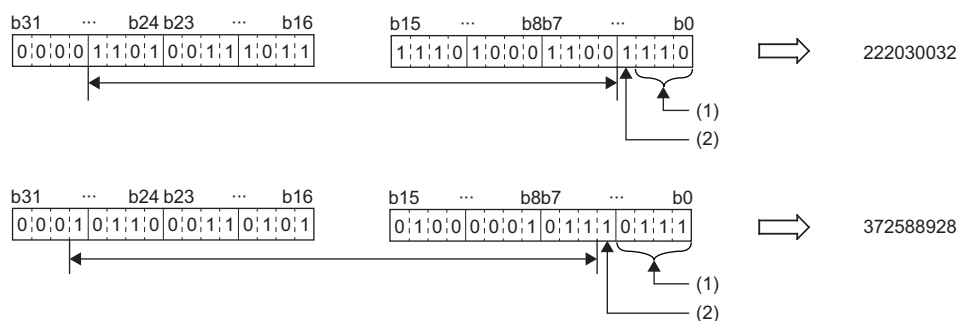
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the 32-bit signed binary data in the device specified by (s) to a single-precision real number, and stores the real number in the device specified by (d).



- A single-precision real number is processed in 32-bit single precision, and therefore the effective number of digits is 24 bits when it is represented in binary and is about 7 digits when represented in decimal. For this reason, if the integer value exceeds the range from -16777216 to 16777215 (24-bit binary value), an error occurs in the converted value. The operation result is an integer value in which the 25th bit from upper bits is rounded off.



- (1) Rounded down.  
(2) Rounded off.

## Operation error

There is no operation error.

# Converting 32-bit unsigned binary data to single-precision real number

## UDINT2FLT(P)

These instructions convert 32-bit unsigned binary data to a single-precision real number.

| Ladder | ST                                                          |
|--------|-------------------------------------------------------------|
|        | <pre>ENO:=UDINT2FLT(EN,s,d); ENO:=UDINT2FLTP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| UDINT2FLT   |                     |
| UDINT2FLTP  |                     |

### Setting data

### Description, range, data type

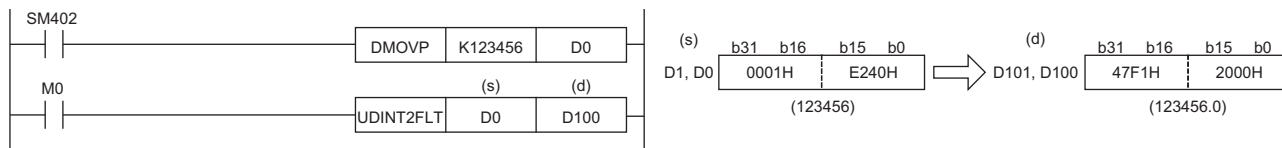
| Operand | Description                                                                                                   | Range           | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------------------|-----------------|------------------------------|-------------------|
| (s)     | Integral data to be converted to a single-precision real number, or the start device containing integral data | 0 to 4294967295 | 32-bit unsigned binary       | ANY32_U           |
| (d)     | Start device for storing the converted single-precision real number                                           | —               | Single-precision real number | ANYREAL_32        |

### Applicable devices

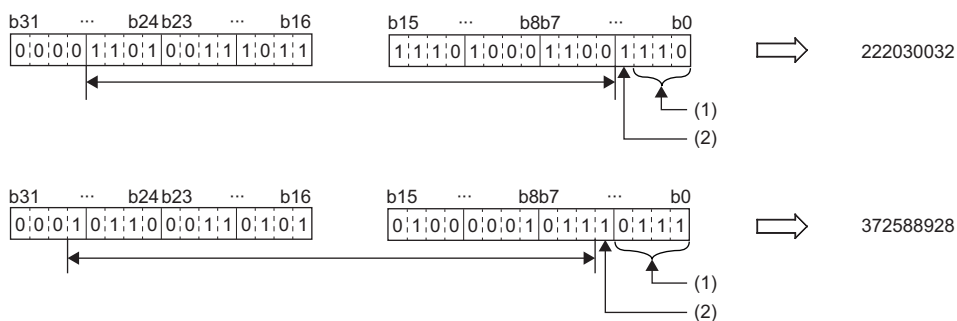
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the 32-bit unsigned binary data in the device specified by (s) to a single-precision real number, and stores the real number in the device specified by (d).



- A single-precision real number is processed in 32-bit single precision, and therefore the effective number of digits is 24 bits when it is represented in binary and is about 7 digits when represented in decimal. For this reason, if the integer value exceeds the range from 0 to 16777215 (24-bit binary value), an error occurs in the converted value. The operation result is an integer value in which the 25th bit from upper bits is rounded off.



- (1) Rounded down.  
(2) Rounded off.

## Operation error

There is no operation error.



# Converting double-precision real number to single-precision real number

## DBL2FLT(P)

These instructions convert a double-precision real number to a single-precision real number.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | ENO:=DBL2FLT(EN,s,d);<br>ENO:=DBL2FLTP(EN,s,d); |
| FBD/LD |                                                 |
|        |                                                 |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DBL2FLT     |                     |
| DBL2FLTP    |                     |

### Setting data

### Description, range, data type

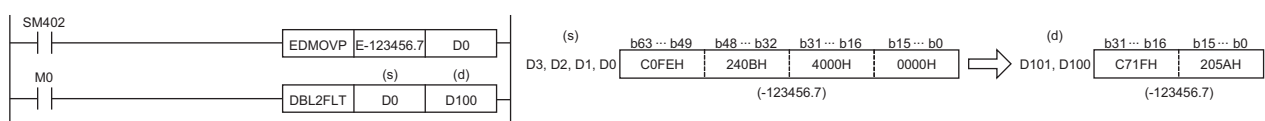
| Operand | Description                                                                                                   | Range                                | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Integral data to be converted to a single-precision real number, or the start device containing integral data | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the converted single-precision real number                                           | —                                    | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                                           | —                                    | Bit                          | BOOL              |
| ENO     | Execution result                                                                                              | —                                    | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              | Word |                                       | Double word |   | Indirect specification | Constant |      |       | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|------------------------|----------|------|-------|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC            | LZ       | K, H | E, \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | ○                      | —        | ○    | —     | —      |
| (d)     | —                                | —    | ○                                     | —           | ○ | ○                      | ○        | —    | —     | —      |

### Processing details

- These instructions convert the double-precision real number in the device specified by (s) to a single-precision real number, and store the real number in the device specified by (d).



- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

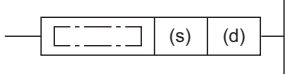
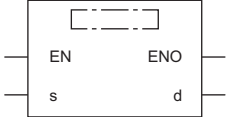
## Operation error

| Error code (SD0) | Description                                                                                                   |
|------------------|---------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                        |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{128}$ |

# Converting 16-bit signed binary data to double-precision real number

## INT2DBL(P)

These instructions convert 16-bit signed binary data to a double-precision real number.

| Ladder                                                                            | ST                                              |
|-----------------------------------------------------------------------------------|-------------------------------------------------|
|  | ENO:=INT2DBL(EN,s,d);<br>ENO:=INT2DBLP(EN,s,d); |
| FBD/LD                                                                            |                                                 |
|  |                                                 |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| INT2DBL     |  |
| INT2DBLP    |  |

## Setting data

## Description, range, data type

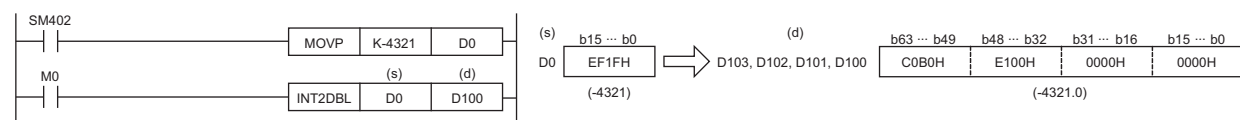
| Operand | Description                                                                                             | Range           | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------------|-----------------|------------------------------|-------------------|
| (s)     | Integral data to be converted to a double-precision real number, or the device containing integral data | -32768 to 32767 | 16-bit signed binary         | ANY16_S           |
| (d)     | Start device for storing the converted double-precision real number                                     | —               | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                                     | —               | Bit                          | BOOL              |
| ENO     | Execution result                                                                                        | —               | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              | Word |                                       |              | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|--------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | ○                                | —    | ○                                     | —            | ○           | —           | —                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —            | —           | ○           | —                      | ○        | — | —  | —      |

## Processing details

These instructions convert the 16-bit signed binary data in the device specified by (s) to a double-precision real number, and store the real number in the device specified by (d).



## Operation error

There is no operation error.

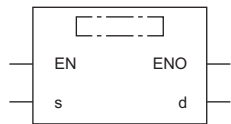
# Converting 16-bit unsigned binary data to double-precision real number

## UINT2DBL(P)

These instructions convert 16-bit unsigned binary data to a double-precision real number.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | ENO:=UINT2DBL(EN,s,d);<br>ENO:=UINT2DBLP(EN,s,d); |

## FBD/LD



### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| UINT2DBL    |                     |
| UINT2DBLP   |                     |

## Setting data

### Description, range, data type

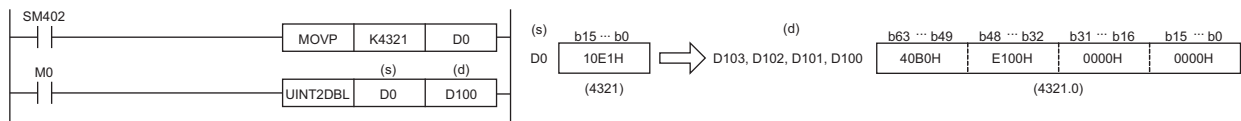
| Operand | Description                                                                                             | Range      | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------------|------------|------------------------------|-------------------|
| (s)     | Integral data to be converted to a double-precision real number, or the device containing integral data | 0 to 65535 | 16-bit unsigned binary       | ANY16_U           |
| (d)     | Start device for storing the converted double-precision real number                                     | —          | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                                     | —          | Bit                          | BOOL              |
| ENO     | Execution result                                                                                        | —          | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |              |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|--------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | —    | ○                                     | —            | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —            | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

These instructions convert the 16-bit unsigned binary data in the device specified by (s) to a double-precision real number, and store the real number in the device specified by (d).



## Operation error

There is no operation error.

# Converting 32-bit signed binary data to double-precision real number

## DINT2DBL(P)

These instructions convert 32-bit signed binary data to a double-precision real number.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | ENO:=DINT2DBL(EN,s,d);<br>ENO:=DINT2DBLP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DINT2DBL    |                     |
| DINT2DBLP   |                     |

### Setting data

### Description, range, data type

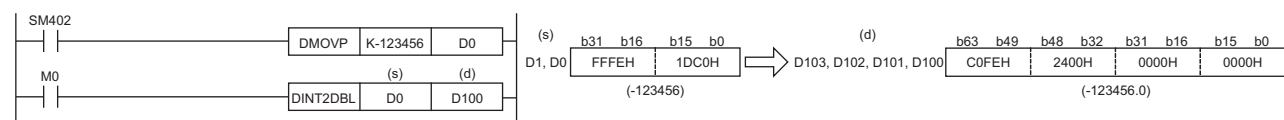
| Operand | Description                                                                                                   | Range                     | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------------------|---------------------------|------------------------------|-------------------|
| (s)     | Integral data to be converted to a double-precision real number, or the start device containing integral data | -2147483648 to 2147483647 | 32-bit signed binary         | ANY32_S           |
| (d)     | Start device for storing the converted double-precision real number                                           | —                         | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                                           | —                         | Bit                          | BOOL              |
| ENO     | Execution result                                                                                              | —                         | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              | Word |                                       |             | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (s)     | ○                                | —    | ○                                     | —           | ○           | ○           | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | —           | ○           | —                      | ○        | — | —  | —      |

### Processing details

These instructions convert the 32-bit signed binary data in the device specified by (s) to a double-precision real number, and store the real number in the device specified by (d).



### Operation error

There is no operation error.

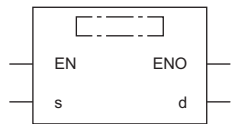
# Converting 32-bit unsigned binary data to double-precision real number

## UDINT2DBL(P)

These instructions convert 32-bit unsigned binary data to a double-precision real number.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | ENO:=UDINT2DBL(EN,s,d);<br>ENO:=UDINT2DBLP(EN,s,d); |

### FBD/LD



### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| UDINT2DBL   |                     |
| UDINT2DBLP  |                     |

### Setting data

### Description, range, data type

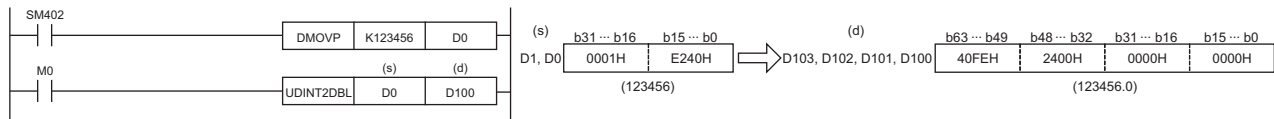
| Operand | Description                                                                                                   | Range           | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------------------|-----------------|------------------------------|-------------------|
| (s)     | Integral data to be converted to a double-precision real number, or the start device containing integral data | 0 to 4294967295 | 32-bit unsigned binary       | ANY32_U           |
| (d)     | Start device for storing the converted double-precision real number                                           | —               | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                                           | —               | Bit                          | BOOL              |
| ENO     | Execution result                                                                                              | —               | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | —    | ○                                     | —           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |

### Processing details

These instructions convert the 32-bit unsigned binary data in the device specified by (s) to a double-precision real number, and store the real number in the device specified by (d).



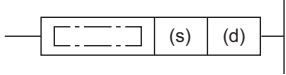
### Operation error

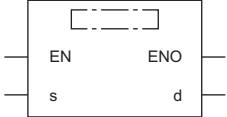
There is no operation error.

# Converting single-precision real number to double-precision real number

## FLT2DBL(P)

These instructions convert a single-precision real number to a double-precision real number.

| Ladder                                                                            | ST                                              |
|-----------------------------------------------------------------------------------|-------------------------------------------------|
|  | ENO:=FLT2DBL(EN,s,d);<br>ENO:=FLT2DBLP(EN,s,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| FLT2DBL     |  |
| FLT2DBLP    |  |

### Setting data

### Description, range, data type

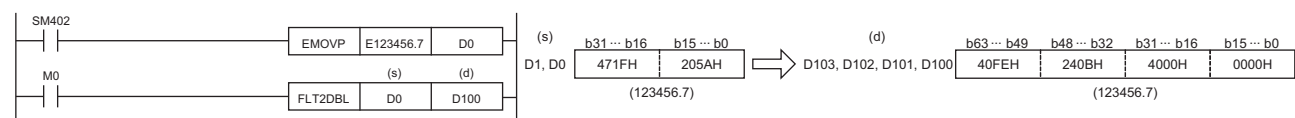
| Operand | Description                                                                                                   | Range                              | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Integral data to be converted to a single-precision real number, or the start device containing integral data | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the converted double-precision real number                                           | —                                  | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                                           | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                                                              | —                                  | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              | Word |                                       | Double word |   | Indirect specification | Constant |      |       | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|------------------------|----------|------|-------|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□  | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□  | Z | LT, LST, LC            | LZ       | K, H | E, \$ |        |
| (s)     | —                                | —    | ○                                     | —           | ○ | ○                      | ○        | —    | ○     | —      |
| (d)     | —                                | —    | ○                                     | —           | — | ○                      | —        | —    | —     | —      |

### Processing details

These instructions convert the single-precision real number in the device specified by (s) to a double-precision real number, and store the double-precision real number in the device specified by (d).



## Operation error

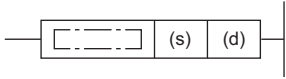
| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

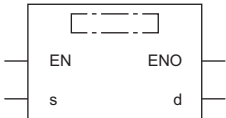


# Converting string data to single-precision real number

## EVAL(P)

These instructions convert a string to a single-precision real number.

| Ladder                                                                            | ST                                                |
|-----------------------------------------------------------------------------------|---------------------------------------------------|
|  | <pre>ENO:=EVAL(EN,s,d); ENO:=EVALP(EN,s,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| EVAL        |  |
| EVALP       |  |

### Setting data

### Descriptions, ranges, and data types

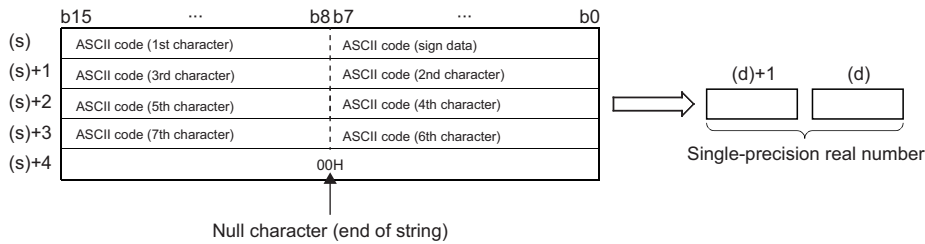
| Operand | Description                                                                                                        | Range | Data type                    | Data type (label) |
|---------|--------------------------------------------------------------------------------------------------------------------|-------|------------------------------|-------------------|
| (s)     | String data to be converted into single-precision real number data, or the start device containing the string data | —     | String                       | ANYSTRING_SINGLE  |
| (d)     | Start device for storing the converted single-precision real number data                                           | —     | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                                                | —     | Bit                          | BOOL              |
| ENO     | Execution result                                                                                                   | —     | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

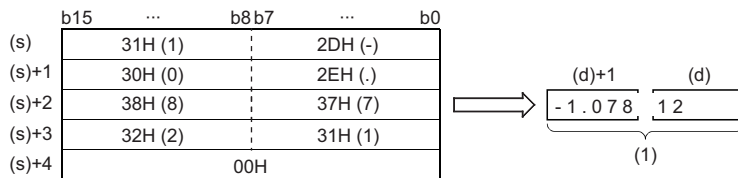
- These instructions convert the string stored in the device number specified by (s) and later to single-precision real number data, and store the converted real number in the device specified by (d).
- The specified string can be converted to a single-precision real number in either decimal point or exponential format.



- "20H" (space) that exists in the middle of the data is ignored.
- The string can consist of up to 24 characters. "20H" (space) and "30H" (0) are counted as one character as well.

### Decimal point format

- When the string in the device specified by (s) is in decimal point format, conversion is performed as shown below.



[1][0][7][8][1][2]

(1) Single-precision real number

- The string in the device specified by (s) to be converted to a single-precision real number is converted by assuming that the six digits excluding the sign, decimal point, and exponent are effective and the seventh and subsequent digits are discarded.



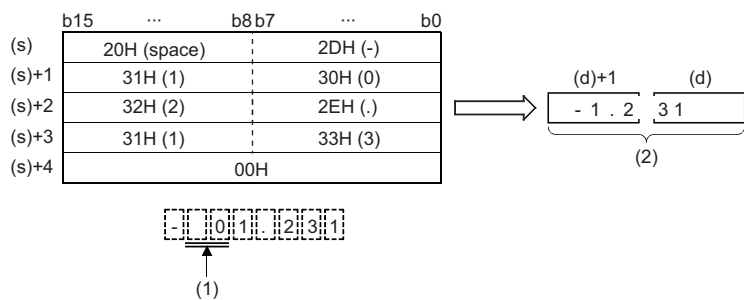
[1][0][3][0][1][5][6][1][2]

(1)

(1) Rounded down.

(2) Single-precision real number

- If 2BH(+) is specified for the sign or the sign is omitted in decimal point format, the converted single-precision real number is treated as a positive value. If 2DH(-) is specified for the sign, it is treated as a negative value.
- If 20H (space) or 30H (0) exists between digits excluding the first 0 in the string in the device specified by (s), the instruction performs conversion by ignoring 20H and 30H.



(1) Ignored.

(2) Single-precision real number

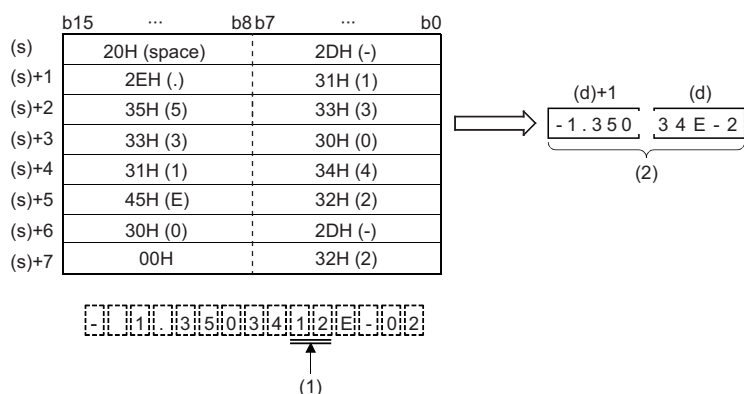
## ■ Exponential format

- When the string in the device specified by (s) is in exponential format, conversion is performed as shown below.



(1) Single-precision real number

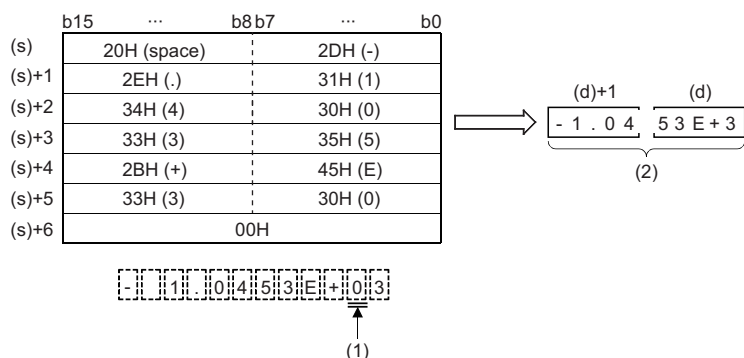
- The string in the device specified by (s) to be converted to a single-precision real number is converted by assuming that the six digits excluding the sign, decimal point, and exponent are effective and the seventh and subsequent digits are discarded.



(1) Rounded down.

(2) Single-precision real number

- If 2BH(+) is specified for the sign or the sign is omitted in exponential format, the converted single-precision real number is treated as a positive value. If 2DH(-) is specified for the sign in the exponent, it is treated as a negative value.
- If 20H (space) or 30H (0) exists between digits excluding the first 0 in the string in the device specified by (s), the instruction performs conversion by ignoring 20H and 30H.
- If 30H (0) exists between "E" and a numerical value in the string in exponential format, the instruction performs conversion by ignoring 30H.



(1) Ignored.

(2) Single-precision real number

- When "20H" (space) is contained in string, "20H" is ignored during conversion.
- The string can consist of up to 24 characters. "20H" (space) and "30H" (0) in a string are counted as one character as well.

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | 00H does not exist within the range of the relevant device specified by (s).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 3281H            | Invalid data that cannot be converted are set to (s). <ul style="list-style-type: none"> <li>The integral part or decimal part contains a character other than 30H (0) to 39H (9).</li> <li>More than one 2EH (.) exists in the specified string.</li> <li>The exponent of the specified string contains a character other than 45H (E), 65H (e), 2BH (+), and 2DH (-).</li> <li>The specified string contains more than one exponent 45H (E) or 65H (e).</li> <li>The exponent in the specified string contains a numerical value consisting of three digits or more.</li> <li>The exponent of the specified string contains more than one sign 2BH (+) or 2DH (-).</li> <li>The specified string contains more than one sign 2BH (+) or 2DH (-) in the integral part of decimal point format or in the mantissa of exponential format.</li> </ul> |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (d)  < 2^{128}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 3285H            | The number of characters in the device specified by (s) and later is 0 or exceeds 24.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

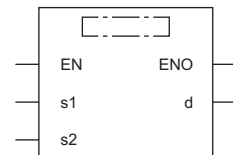
# Converting BCD format data to single-precision real number

## EREXP(P)

These instructions convert BCD floating point format data to single-precision real number data in accordance with the specified number of digits in the decimal part.

| Ladder | ST                                                          |
|--------|-------------------------------------------------------------|
|        | <pre>ENO:=EREXP(EN,s1,s2,d); ENO:=EREXPP(EN,s1,s2,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| EREXP       |                     |
| EREXPP      |                     |

## Setting data

## Descriptions, ranges, and data types

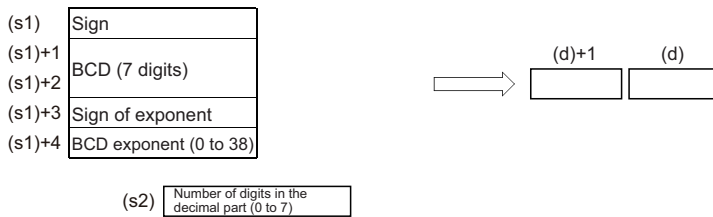
| Operand | Description                                             | Range  | Data type                    | Data type (label)                      |
|---------|---------------------------------------------------------|--------|------------------------------|----------------------------------------|
| (s1)    | Start device containing BCD floating point format data  | —      | 16-bit signed binary         | ANY16_ARRAY<br>(Number of elements: 5) |
| (s2)    | Number of digits in the decimal part                    | 0 to 7 | 16-bit signed binary         | ANY16                                  |
| (d)     | Start device for storing a single-precision real number | —      | Single-precision real number | ANYREAL_32                             |
| EN      | Execution condition                                     | —      | Bit                          | BOOL                                   |
| ENO     | Execution result                                        | —      | Bit                          | BOOL                                   |

## Applicable devices

| Operand | Bit                              |     | Word                                  |             |   |             | Double word |      | Indirect specification | Constant |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|-------------|------|------------------------|----------|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |        |
| (s1)    | —                                | —   | ○                                     | —           | — | —           | —           | ○    | —                      | —        | —  | — |        |
| (s2)    | ○                                | ○   | ○                                     | ○           | ○ | —           | —           | ○    | ○                      | —        | —  | — |        |
| (d)     | —                                | —   | ○                                     | ○           | ○ | ○           | ○           | ○    | —                      | —        | —  | — |        |

## Processing details

- These instructions convert the BCD floating-point format data stored in the device specified by (s1) and later to single-precision real number data in accordance with the number of decimal places stored in the device specified by (s2), and store the converted data in the device number specified by (d) and later.

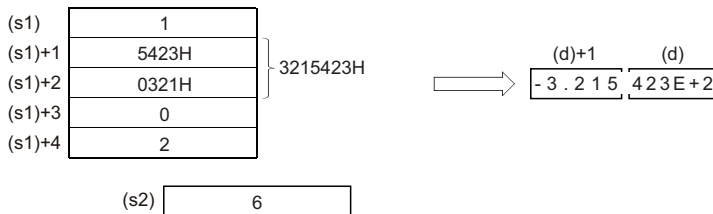


(s1): Sign (Positive: 0, Negative: 1)  
 (s1)+1, (s1)+2: BCD (7 digits)  
 (s1)+3: Sign of exponent (Positive: 0, Negative: 1)  
 (s1)+4: BCD exponent (0 to 38)  
 (s2): Number of digits in the decimal part (0 to 7)  
 (d)+1, (d): Single-precision real number

- For the sign in (s1) and exponent sign in (s1)+3, 0 is set for positive and 1 is set for negative.
- A value of 0 to 38 can be set for the BCD exponent in (s1)+4.
- A value of 0 to 7 can be set for the number of decimal digits in the device specified by (s2).

### Ex.

When 6 is specified in (s2)



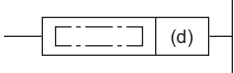
## Operation error

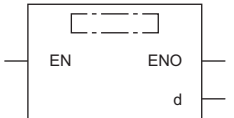
| Error code (SD0) | Description                                                                                                   |
|------------------|---------------------------------------------------------------------------------------------------------------|
| 3281H            | The value set to (s1) as sign data is not 0 or 1.                                                             |
|                  | A value other than 0 to 9 exists at any digit of data set to (s1)+1 and (s1)+2.                               |
|                  | The value set to (s1)+3 as sign data of exponent is not 0 or 1.                                               |
|                  | The exponent data set to (s1)+4 is out of the range, 0 to 38.                                                 |
|                  | The value set to (s2) as the number of digits in the decimal part is out of the range, 0 to 7.                |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{128}$ |

# Inverting the sign of single-precision real number

## ENEG(P)

These instructions invert the sign of single-precision real number data.

| Ladder                                                                            | ST                                            |
|-----------------------------------------------------------------------------------|-----------------------------------------------|
|  | <pre>ENO:=ENEG(EN,d); ENO:=ENEGP(EN,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| ENEG        |  |
| ENEGP       |  |

### Setting data

### Description, range, data type

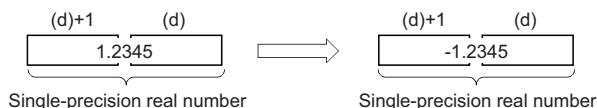
| Operand | Description                                                                             | Range | Data type                    | Data type (label) |
|---------|-----------------------------------------------------------------------------------------|-------|------------------------------|-------------------|
| (d)     | Start device containing the single-precision real number data subject to sign inversion | —     | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                     | —     | Bit                          | BOOL              |
| ENO     | Execution result                                                                        | —     | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |            | Double word |             | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|-------------|-------------|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |        |
| (d)     | —                                | —    | ○                                     | ○          | ○           | ○           | ○                      | —        | — | —  | —      |

### Processing details

- These instructions invert the sign of the single-precision real number in the device specified by (d) and store the inverted data in the devices specified by (d).



- The instructions are used to invert positive and negative signs.

### Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |



# Inverting the sign of double-precision real number

## EDNEG(P)

These instructions invert the sign of double-precision real number data.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | <pre>ENO:=EDNEG(EN,d); ENO:=EDNEGP(EN,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| EDNEG       |                     |
| EDNEGP      |                     |

### Setting data

### Description, range, data type

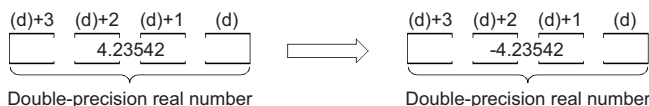
| Operand | Description                                                                        | Range | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------------|-------|------------------------------|-------------------|
| (d)     | Start device containing the double-precision real number subject to sign inversion | —     | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                | —     | Bit                          | BOOL              |
| ENO     | Execution result                                                                   | —     | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   |             | Double word |      | Indirect specification | Constant |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|-------------|------|------------------------|----------|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ          | K, H |                        | E        | \$ |   |        |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —           | ○    | —                      | —        | —  | — |        |

### Processing details

- These instructions invert the sign of the double-precision real number data in the device specified by (d) and store the inverted data in the device specified by (d).



- The instructions are used to invert positive and negative signs.

### Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

# Transferring single-precision real number

## EMOV(P)

These instructions transfer single-precision real number data to the specified device.

| Ladder | ST                                       |
|--------|------------------------------------------|
|        | ENO:=EMOV(EN,s,d);<br>ENO:=EMOVP(EN,s,d) |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| EMOV        |                     |
| EMOVP       |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                                  | Range                              | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Data to be transferred or start device containing the data to be transferred | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing transferred data                                    | —                                  | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                          | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                             | —                                  | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

These instructions transfer the single-precision real number data stored in the device specified by (s) to the device specified by (d).



### Operation error

There is no operation error.

# Transferring double-precision real number

## EDMOV(P)

These instructions transfer double-precision real number data to the specified device.

| Ladder | ST                                          |
|--------|---------------------------------------------|
|        | ENO:=EDMOV(EN,s,d);<br>ENO:=EDMOVP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| EDMOV       |                     |
| EDMOVP      |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                                  | Range                                | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Data to be transferred or start device containing the data to be transferred | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing transferred data                                    | —                                    | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                          | —                                    | Bit                          | BOOL              |
| ENO     | Execution result                                                             | —                                    | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |

### Processing details

These instructions transfer the double-precision real number data stored in the device specified by (s) to the device specified by (d).



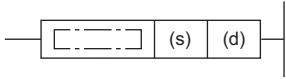
### Operation error

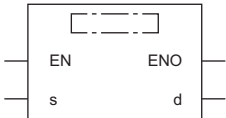
There is no operation error.

# Calculating the sine of single-precision real number

## SIN(P)

These instructions calculate the sine of the angle specified by a single-precision real number.

| Ladder                                                                            | ST*1               |
|-----------------------------------------------------------------------------------|--------------------|
|  | ENO:=SINP(EN,s,d); |

| FBD/LD*1                                                                          |
|-----------------------------------------------------------------------------------|
|  |

\*1 The SIN instruction does not support the ST and FBD/LD. Use the standard function, SIN.

 Page 1323 SIN(\_E)

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| SIN         |  |
| SINP        |  |

## Setting data

## Description, range, data type

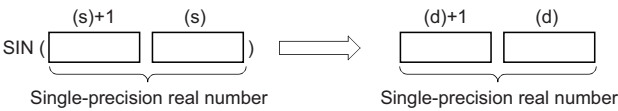
| Operand | Description                                                                         | Range                              | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Angle data used for sine calculation, or the start device containing the angle data | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                       | —                                  | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                 | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                                    | —                                  | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions calculate the sine of the angle specified by (s), and store the operation result in the device specified by (d).



- Set the angle data in radians ( $\text{angle} \times \pi \div 180$ ).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

### Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

#### Point

For the angle $\leftrightarrow$ radian conversion, refer to the RAD(P) and DEG(P) instructions.

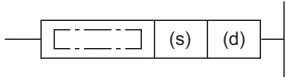
Page 902 RAD(P)

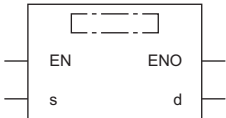
Page 904 DEG(P)

# Calculating the cosine of single-precision real number

## COS(P)

These instructions calculate the cosine of the angle specified by a single-precision real number.

| Ladder                                                                            | ST*1               |
|-----------------------------------------------------------------------------------|--------------------|
|  | ENO:=COSP(EN,s,d); |

| FBD/LD*1                                                                          |
|-----------------------------------------------------------------------------------|
|  |

\*1 The COS instruction does not support the ST and FBD/LD. Use the standard function, COS.

Page 1324 COS(\_E)

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| COS         |  |
| COSP        |  |

## Setting data

## Description, range, data type

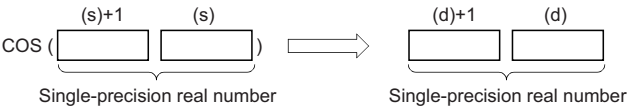
| Operand | Description                                                                           | Range                              | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Angle data used for cosine calculation, or the start device containing the angle data | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                         | —                                  | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                   | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                                      | —                                  | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | ○         | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions calculate the cosine of the angle specified by (s), and store the operation result in the device specified by (d).



- Set the angle data in radians ( $\text{angle} \times \pi \div 180$ ).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

### Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

For the angle↔radian conversion, refer to the RAD(P) and DEG(P) instructions.

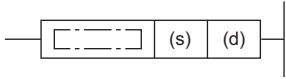
Page 902 RAD(P)

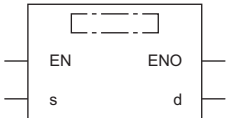
Page 904 DEG(P)

# Calculating the tangent of single-precision real number

## TAN(P)

These instructions calculate the tangent of the angle specified by a single-precision real number.

| Ladder                                                                            | ST*1               |
|-----------------------------------------------------------------------------------|--------------------|
|  | ENO:=TANP(EN,s,d); |

| FBD/LD*1                                                                          |
|-----------------------------------------------------------------------------------|
|  |

\*1 The TAN instruction does not support the ST and FBD/LD. Use the standard function, TAN.

 Page 1325 TAN(\_E)

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| TAN         |  |
| TANP        |  |

## Setting data

## Description, range, data type

| Operand | Description                                                                            | Range                              | Data type                    | Data type (label) |
|---------|----------------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Angle data used for tangent calculation, or the start device containing the angle data | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                          | —                                  | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                    | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                                       | —                                  | Bit                          | BOOL              |

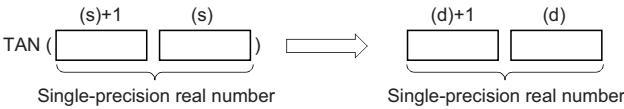
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |



### Processing details

- These instructions calculate the tangent of the angle specified by (s), and store the operation result in the device specified by (d).



- Set the angle data in radians (angle×π÷180).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

### Precautions

If the angle specified by (s) is  $\pi/2$  radian or  $(3/2)\pi$  radian, no operation error will be issued because of the truncation error in the radian value.

### Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

For the angle↔radian conversion, refer to the RAD(P) and DEG(P) instructions.

Page 902 RAD(P)

Page 904 DEG(P)

# Calculating the arc sine of single-precision real number

## ASIN(P)

These instructions calculate the angle from the sine specified by a single-precision real number.

| Ladder | ST*1                |
|--------|---------------------|
|        | ENO:=ASINP(EN,s,d); |

| FBD/LD*1 |
|----------|
|          |

\*1 The ASIN instruction does not support the ST and FBD/LD. Use the standard function, ASIN.

Page 1326 ASIN(\_E)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ASIN        |                     |
| ASINP       |                     |

## Setting data

## Description, range, data type

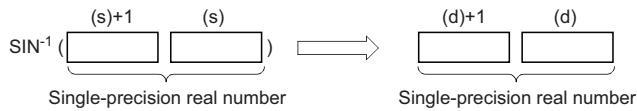
| Operand | Description                                                                           | Range       | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------|-------------|------------------------------|-------------------|
| (s)     | Sine data used for arc sine calculation, or the start device containing the sine data | -1.0 to 1.0 | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                         | —           | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                   | —           | Bit                          | BOOL              |
| ENO     | Execution result                                                                      | —           | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the angle based on the sine data in the device specified by (s), and store the operation result in the device number specified by (d).



- The sine data in the device specified by (s) can be set in the range from -1.0 to 1.0.
- The angle (operation result) is stored in radians in the device specified by (d).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |
| 3285H            | The value in the device specified by (s) is out of the range, -1.0 to 1.0.             |

### Point

For the angle↔radian conversion, refer to the RAD(P) and DEG(P) instructions.

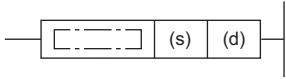
☞ Page 902 RAD(P)

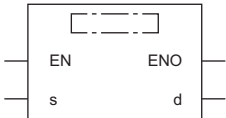
☞ Page 904 DEG(P)

# Calculating the arc cosine of single-precision real number

## ACOS(P)

These instructions calculate the angle from the cosine specified by a single-precision real number.

| Ladder                                                                            | ST*1               |
|-----------------------------------------------------------------------------------|--------------------|
|  | ENO:=ACOSP(EN,s,d) |

| FBD/LD*1                                                                          |
|-----------------------------------------------------------------------------------|
|  |

\*1 The ACOS instruction does not support the ST and FBD/LD. Use the standard function, ACOS.

Page 1327 ACOS(\_E)

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| ACOS        |  |
| ACOSP       |  |

## Setting data

## Description, range, data type

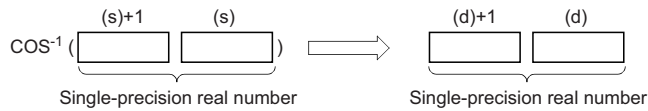
| Operand | Description                                                                                 | Range       | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------|-------------|------------------------------|-------------------|
| (s)     | Cosine data used for arc cosine calculation, or the start device containing the cosine data | -1.0 to 1.0 | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                               | —           | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                         | —           | Bit                          | BOOL              |
| ENO     | Execution result                                                                            | —           | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the angle based on the cosine data in the device specified by (s), and store the operation result in the device number specified by (d).



- The cosine data in the device specified by (s) can be set in the range from -1.0 to 1.0.
- The angle (operation result) is stored in radians in the device specified by (d).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |
| 3285H            | The value in the device specified by (s) is out of the range, -1.0 to 1.0.             |

### Point

For the angle↔radian conversion, refer to the RAD(P) and DEG(P) instructions.

☞ Page 902 RAD(P)

☞ Page 904 DEG(P)

# Calculating the arc tangent of single-precision real number

## ATAN(P)

These instructions calculate the angle from the tangent specified by a single-precision real number.

| Ladder | ST*1                |
|--------|---------------------|
|        | ENO:=ATANP(EN,s,d); |

| FBD/LD*1 |
|----------|
|          |

\*1 The ATAN instruction does not support the ST and FBD/LD. Use the standard function, ATAN.

Page 1328 ATAN(\_E)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ATAN        |                     |
| ATANP       |                     |

## Setting data

## Description, range, data type

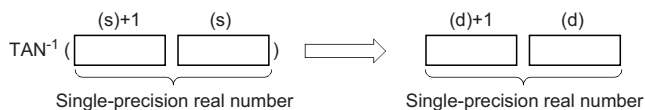
| Operand | Description                                                                                    | Range                              | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Tangent data used for arc tangent calculation, or the start device containing the tangent data | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                                  | —                                  | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                            | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                                               | —                                  | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the angle based on the tangent data in the device specified by (s), and store the operation result in the device number specified by (d).



- The angle (operation result) is stored in radians in the device specified by (d).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

### Point

For the angle↔radian conversion, refer to the RAD(P) and DEG(P) instructions.

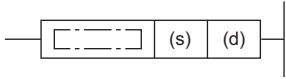
Page 902 RAD(P)

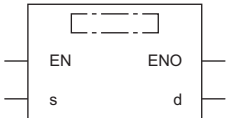
Page 904 DEG(P)

# Calculating the sine of double-precision real number

## SIND(P)

These instructions calculate the sine of the angle specified by a double-precision real number.

| Ladder                                                                            | ST*1                |
|-----------------------------------------------------------------------------------|---------------------|
|  | ENO:=SINDP(EN,s,d); |

| FBD/LD*1                                                                          |
|-----------------------------------------------------------------------------------|
|  |

\*1 The SIND instruction does not support the ST and FBD/LD. Use the standard function, SIN.

 Page 1323 SIN(\_E)

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| SIND        |  |
| SINDP       |  |

## Setting data

## Description, range, data type

| Operand | Description                                                                         | Range                                | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Angle data used for sine calculation, or the start device containing the angle data | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                       | —                                    | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                 | —                                    | Bit                          | BOOL              |
| ENO     | Execution result                                                                    | —                                    | Bit                          | BOOL              |

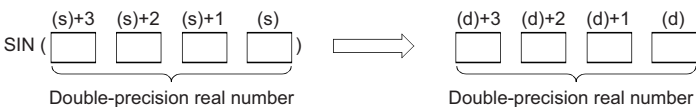
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |



## Processing details

- These instructions calculate the sine of the angle specified by (s), and store the operation result in the device specified by (d).



- Set the angle data in radians ( $\text{angle} \times \pi \div 180$ ).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

### Point

For the angle↔radian conversion, refer to the RADD(P) and DEGD(P) instructions.

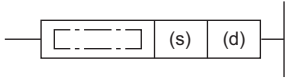
Page 906 RADD(P)

Page 908 DEGD(P)

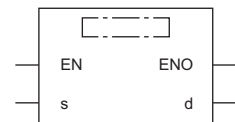
# Calculating the cosine of double-precision real number

## COSD(P)

These instructions calculate the cosine of the angle specified by a double-precision real number.

| Ladder                                                                            | ST*1                |
|-----------------------------------------------------------------------------------|---------------------|
|  | ENO:=COSDP(EN,s,d); |

## FBD/LD\*1



\*1 The COSD instruction does not support the ST and FBD/LD. Use the standard function, COS.

Page 1324 COS(\_E)

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| COSD        |  |
| COSDP       |  |

## Setting data

## Descriptions, ranges, and data types

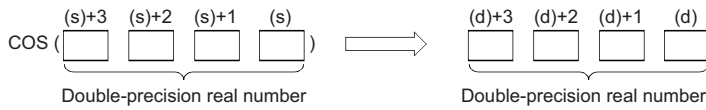
| Operand | Description                                                                           | Range                              | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Angle data used for cosine calculation, or the start device containing the angle data | $0, 2^{-1022} \leq (s) < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                         | —                                  | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                   | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                                      | —                                  | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the cosine of the angle specified by (s), and store the operation result in the device specified by (d).



- Set the angle data in radians ( $\text{angle} \times \pi \div 180$ ).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

### Point

For the angle $\leftrightarrow$ radian conversion, refer to the RADD(P) and DEGD(P) instructions.

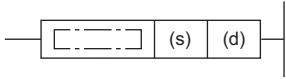
Page 906 RADD(P)

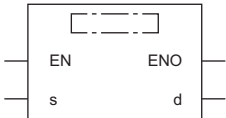
Page 908 DEGD(P)

# Calculating the tangent of double-precision real number

## TAND(P)

These instructions calculate the tangent of the angle specified by a double-precision real number.

| Ladder                                                                            | ST*1                |
|-----------------------------------------------------------------------------------|---------------------|
|  | ENO:=TANDP(EN,s,d); |

| FBD/LD*1                                                                          |
|-----------------------------------------------------------------------------------|
|  |

\*1 The TAND instruction does not support the ST and FBD/LD. Use the standard function, TAN.

Page 1325 TAN(\_E)

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| TAND        |  |
| TANDP       |  |

## Setting data

## Description, range, data type

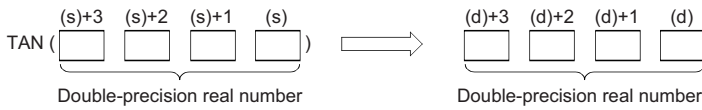
| Operand | Description                                                                            | Range                                | Data type                    | Data type (label) |
|---------|----------------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Angle data used for tangent calculation, or the start device containing the angle data | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                          | —                                    | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                    | —                                    | Bit                          | BOOL              |
| ENO     | Execution result                                                                       | —                                    | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |               |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|---------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□, G□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —             | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —             | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the tangent of the angle specified by (s), and store the operation result in the device specified by (d).



- Set the angle data in radians (angle $\times\pi\div180$ ).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Precautions

If the angle specified by (s) is  $\pi/2$  radian or  $(3/2)\pi$  radian, no operation error will be issued because of the truncation error in the radian value.

## Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

### Point

For the angle $\leftrightarrow$ radian conversion, refer to the RADD(P) and DEGD(P) instructions.

Page 906 RADD(P)

Page 908 DEGD(P)

# Calculating the arc sine of double-precision real number

## ASIND(P)

These instructions calculate the angle from the sine specified by a double-precision real number.

| Ladder | ST*1                |
|--------|---------------------|
|        | ENO:=ASINDP(EN,s,d) |

| FBD/LD*1 |
|----------|
|          |

\*1 The ASIND instruction does not support the ST and FBD/LD. Use the standard function, ASIN.

Page 1326 ASIN(\_E)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ASIND       |                     |
| ASINDP      |                     |

## Setting data

## Description, range, data type

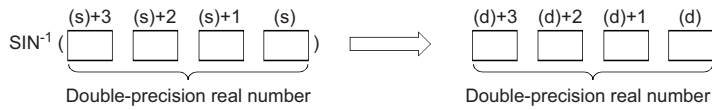
| Operand | Description                                                                           | Range       | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------|-------------|------------------------------|-------------------|
| (s)     | Sine data used for arc sine calculation, or the start device containing the sine data | -1.0 to 1.0 | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                         | —           | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                   | —           | Bit                          | BOOL              |
| ENO     | Execution result                                                                      | —           | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the angle based on the sine data in the device specified by (s), and store the operation result in the device number specified by (d).



- The sine data in the device specified by (s) can be set in the range from -1.0 to 1.0.
- The angle (operation result) is stored in radians in the device specified by (d).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |
| 3285H            | The value in the device specified by (s) is out of the range, -1.0 to 1.0.             |

### Point

For the angle $\leftrightarrow$ radian conversion, refer to the RADD(P) and DEGD(P) instructions.

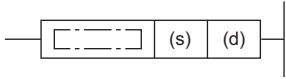
Page 906 RADD(P)

Page 908 DEGD(P)

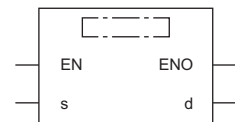
# Calculating the arc cosine of double-precision real number

## ACOSD(P)

These instructions calculate the angle from the cosine specified by a double-precision real number.

| Ladder                                                                            | ST <sup>*1</sup>     |
|-----------------------------------------------------------------------------------|----------------------|
|  | ENO:=ACOSDP(EN,s,d); |

## FBD/LD<sup>\*1</sup>



<sup>\*1</sup> The ACOSD instruction does not support the ST and FBD/LD. Use the standard function, ACOS.

 Page 1327 ACOS(\_E)

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| ACOSD       |  |
| ACOSDP      |  |

## Setting data

## Description, range, data type

| Operand | Description                                                                                 | Range       | Data type                    | Data type (label) |
|---------|---------------------------------------------------------------------------------------------|-------------|------------------------------|-------------------|
| (s)     | Cosine data used for arc cosine calculation, or the start device containing the cosine data | -1.0 to 1.0 | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                               | —           | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                         | —           | Bit                          | BOOL              |
| ENO     | Execution result                                                                            | —           | Bit                          | BOOL              |

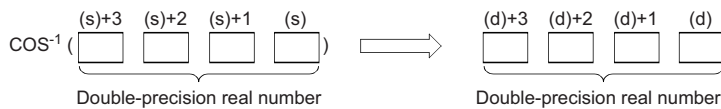
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |



## Processing details

- These instructions calculate the angle based on the cosine data in the device specified by (s), and store the operation result in the device number specified by (d).



- The cosine data in the device specified by (s) can be set in the range from -1.0 to 1.0.
- The angle (operation result) is stored in radians in the device specified by (d).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |
| 3285H            | The value in the device specified by (s) is out of the range, -1.0 to 1.0.             |

### Point

For the angle↔radian conversion, refer to the RADD(P) and DEGD(P) instructions.

☞ Page 906 RADD(P)

☞ Page 908 DEGD(P)

# Calculating the arc tangent of double-precision real number

## ATAND(P)

These instructions calculate the angle from the tangent specified by a double-precision real number.

| Ladder | ST*1                 |
|--------|----------------------|
|        | ENO:=ATANDP(EN,s,d); |

| FBD/LD*1 |
|----------|
|          |

\*1 The ATAND instruction does not support the ST and FBD/LD. Use the standard function, ATAN.

Page 1328 ATAN(\_E)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ATAND       |                     |
| ATANDP      |                     |

## Setting data

## Description, range, data type

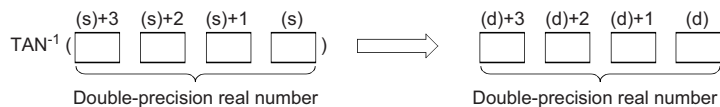
| Operand | Description                                                                                    | Range                                | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Tangent data used for arc tangent calculation, or the start device containing the tangent data | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                                  | —                                    | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                            | —                                    | Bit                          | BOOL              |
| ENO     | Execution result                                                                               | —                                    | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the angle based on the tangent data in the device specified by (s), and store the operation result in the device number specified by (d).



- The angle (operation result) is stored in radians in the device specified by (d).
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

### Point

For the angle↔radian conversion, refer to the RADD(P) and DEGD(P) instructions.

☞ Page 906 RADD(P)

☞ Page 908 DEGD(P)

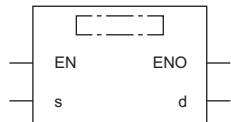
# Calculating the sine of BCD data

## BSIN(P)

These instructions calculate the sine of the angle specified by a BCD value.

| Ladder | ST                                        |
|--------|-------------------------------------------|
|        | ENO:=BSIN(EN,s,d);<br>ENO:=BSINP(EN,s,d); |

## FBD/LD



### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BSIN        |                     |
| BSINP       |                     |

## Setting data

### Descriptions, ranges, and data types

| Operand | Description                                                       | Range     | Data type   | Data type (label)                      |
|---------|-------------------------------------------------------------------|-----------|-------------|----------------------------------------|
| (s)     | Data used for sine calculation, or the device containing the data | 0 to 9999 | BCD 4-digit | ANY16                                  |
| (d)     | Start device for storing the operation result                     | —         | BCD 4-digit | ANY16_ARRAY<br>(Number of elements: 3) |
| EN      | Execution condition                                               | —         | Bit         | BOOL                                   |
| ENO     | Execution result                                                  | —         | Bit         | BOOL                                   |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the sine of the angle specified by (s), and store the sign of the operation result in the device specified by (d) and the operation result in the devices specified by (d)+1 and (d)+2.

SIN (s) =

(d): Sign

(d)+1: Integral part

(d)+2: Decimal part

- For the value to be specified in (s), set a value from 0 to 360° (in the DEG. unit) as a BCD value.
- For the sign of the operation result to be stored in the device specified by (d), 0 is stored when the operation result is positive and 1 is stored when the operation result is negative.
- The operation result to be stored in the devices specified by (d)+1 and (d)+2 is a BCD value in the range from -1.000 to 1.000.
- The operation result is a value whose 5th decimal place is rounded off.

## Operation error

| Error code<br>(SD0) | Description                                                                                                                                                                              |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H               | An out-of-range value is set to (s). <ul style="list-style-type: none"> <li>The specified data is not a BCD value.</li> <li>The specified data is out of the range, 0 to 360.</li> </ul> |

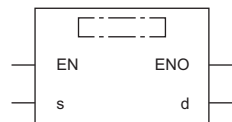
# Calculating the cosine of BCD data

## BCOS(P)

These instructions calculate the cosine of the angle specified by a BCD value.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | <pre>ENO:=BCOS(EN,s,d); ENO:=BCOSP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BCOS        |                     |
| BCOSP       |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                         | Range     | Data type   | Data type (label)                      |
|---------|---------------------------------------------------------------------|-----------|-------------|----------------------------------------|
| (s)     | Data used for cosine calculation, or the device containing the data | 0 to 9999 | BCD 4-digit | ANY16                                  |
| (d)     | Start device for storing the operation result                       | —         | BCD 4-digit | ANY16_ARRAY<br>(Number of elements: 3) |
| EN      | Execution condition                                                 | —         | Bit         | BOOL                                   |
| ENO     | Execution result                                                    | —         | Bit         | BOOL                                   |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the cosine of the angle specified by (s), and store the sign of the operation result in the word device specified by (d) and the operation result in the word devices specified by (d)+1 and (d)+2.

$\text{COS}(s) = \boxed{\text{(d)}} \boxed{\text{(d)+1}} . \boxed{\text{(d)+2}}$

(d): Sign

(d)+1: Integral part

(d)+2: Decimal part

- For the value to be specified in (s), set a value from 0 to 360° (in the DEG. unit) as a BCD value.
- For the sign of the operation result to be stored in the device specified by (d), 0 is stored when the operation result is positive and 1 is stored when the operation result is negative.
- The operation result to be stored in the devices specified by (d)+1 and (d)+2 is a BCD value in the range from -1.000 to 1.000.
- The operation result is a value whose 5th decimal place is rounded off.

## Operation error

| Error code<br>(SD0) | Description                                                                                                                                                                              |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H               | An out-of-range value is set to (s). <ul style="list-style-type: none"> <li>The specified data is not a BCD value.</li> <li>The specified data is out of the range, 0 to 360.</li> </ul> |

# Calculating the tangent of BCD data

## BTAN(P)

These instructions calculate the tangent of the angle specified by a BCD value.

| Ladder | ST                                        |
|--------|-------------------------------------------|
|        | ENO:=BTAN(EN,s,d);<br>ENO:=BTANP(EN,s,d); |
| FBD/LD |                                           |
|        |                                           |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BTAN        |                     |
| BTANP       |                     |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                                          | Range     | Data type   | Data type (label)                      |
|---------|----------------------------------------------------------------------|-----------|-------------|----------------------------------------|
| (s)     | Data used for tangent calculation, or the device containing the data | 0 to 9999 | BCD 4-digit | ANY16                                  |
| (d)     | Start device for storing the operation result                        | —         | BCD 4-digit | ANY16_ARRAY<br>(Number of elements: 3) |
| EN      | Execution condition                                                  | —         | Bit         | BOOL                                   |
| ENO     | Execution result                                                     | —         | Bit         | BOOL                                   |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |



## Processing details

- These instructions calculate the tangent of the angle specified by (s), and store the sign of the operation result in the device specified by (d) and the operation result in the devices specified by (d)+1 and (d)+2.

$$\text{TAN (s)} = \boxed{\text{(d)}} \boxed{\text{(d)+1}} . \boxed{\text{(d)+2}}$$

(d): Sign

(d)+1: Integral part

(d)+2: Decimal part

- For the value to be specified in (s), set a value from 0 to 360° (in the DEG. unit) as a BCD value.
- For the sign of the operation result to be stored in the device specified by (d), 0 is stored when the operation result is positive and 1 is stored when the operation result is negative.
- The operation result to be stored in the devices specified by (d)+1 and (d)+2 is a BCD value in the range from -57.2901 to 57.2903.
- The operation result is a value whose 5th decimal place is rounded off.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                          |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | An out-of-range value is set to (s). <ul style="list-style-type: none"> <li>The specified data is not a BCD value.</li> <li>The specified data is out of the range, 0 to 360.</li> <li>The specified data is 90° or 270°.</li> </ul> |

# Calculating the arc sine of BCD data

## BASIN(P)

These instructions calculate the arc sine of the angle specified by a BCD value.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | <pre>ENO:=BASIN(EN,s,d); ENO:=BASINP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BASIN       |                     |
| BASINP      |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                    | Range     | Data type   | Data type (label)                      |
|---------|----------------------------------------------------------------|-----------|-------------|----------------------------------------|
| (s)     | Start device containing the data used for arc sine calculation | 0 to 9999 | BCD 4-digit | ANY16_ARRAY<br>(Number of elements: 3) |
| (d)     | Device for storing the operation result                        | —         | BCD 4-digit | ANY16                                  |
| EN      | Execution condition                                            | —         | Bit         | BOOL                                   |
| ENO     | Execution result                                               | —         | Bit         | BOOL                                   |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the arc sine of the value specified by (s), and store the operation result (angle) in the device specified by (d).

$$\text{SIN}^{-1} \left( \boxed{\text{(s)}} \boxed{\text{(s)+1}} \boxed{\text{(s)+2}} \right) = (\text{d})$$

(s): Sign

(s)+1: Integral part

(s)+2: Decimal part

- Set the sign of the calculation data in the device specified by (s). Store 0 when the calculation data is positive, or store 1 when the calculation data is negative.
- Store a BCD value for the integral part of calculation data in (s)+1 and a BCD value for the decimal part in (s)+2. (A value from 0 to 1.0000 can be set.)
- The operation result to be stored in the device specified by (d) is a BCD value in the range from 0 to 90° or 270 to 360° (in DEG. unit).
- The operation result is a value whose decimal part is rounded off.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | An out-of-range value is set to (s). <ul style="list-style-type: none"> <li>The specified data is not a BCD value.</li> <li>The specified data is out of the range, -1.0000 to 1.0000.</li> </ul> |

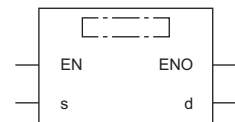
# Calculating the arc cosine of BCD data

## BACOS(P)

These instructions calculate the arc cosine of the angle specified by a BCD value.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | <pre>ENO:=BACOS(EN,s,d); ENO:=BACOSP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BACOS       |                     |
| BACOSP      |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                      | Range     | Data type   | Data type (label)                      |
|---------|------------------------------------------------------------------|-----------|-------------|----------------------------------------|
| (s)     | Start device containing the data used for arc cosine calculation | 0 to 9999 | BCD 4-digit | ANY16_ARRAY<br>(Number of elements: 3) |
| (d)     | Device for storing the operation result                          | —         | BCD 4-digit | ANY16                                  |
| EN      | Execution condition                                              | —         | Bit         | BOOL                                   |
| ENO     | Execution result                                                 | —         | Bit         | BOOL                                   |

## Applicable devices

| Operand | Bit                              |      | Word                                  |              |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|--------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —            | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○            | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the arc cosine of the value specified by (s), and store the operation result (angle) in the device specified by (d).

$$\text{COS}^{-1} \left( \boxed{\text{(s)}} \boxed{\text{(s)+1}} \boxed{\text{(s)+2}} \right) = \text{(d)}$$

(s): Sign

(s)+1: Integral part

(s)+2: Decimal part

- Set the sign of the calculation data in the device specified by (s). Store 0 when the calculation data is positive, or store 1 when the calculation data is negative.
- Store a BCD value for the integral part of calculation data in (s)+1 and a BCD value for the decimal part in (s)+2. (A value from 0 to 1.0000 can be set.)
- The operation result to be stored in the device specified by (d) is a BCD value in the range from 0 to 180° (in DEG. unit).
- The operation result is a value whose decimal part is rounded off.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | An out-of-range value is set to (s). <ul style="list-style-type: none"> <li>The specified data is not a BCD value.</li> <li>The specified data is out of the range, -1.0000 to 1.0000.</li> </ul> |

# Calculating the arc tangent of BCD data

## BATAN(P)

These instructions calculate the arc tangent of the angle specified by a BCD value.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | <pre>ENO:=BATAN(EN,s,d); ENO:=BATANP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| BATAN       |                     |
| BATANP      |                     |

## Setting data

### ■Descriptions, ranges, and data types

| Operand | Description                                                       | Range     | Data type   | Data type (label)                      |
|---------|-------------------------------------------------------------------|-----------|-------------|----------------------------------------|
| (s)     | Start device containing the data used for arc tangent calculation | 0 to 9999 | BCD 4-digit | ANY16_ARRAY<br>(Number of elements: 3) |
| (d)     | Device for storing the operation result                           | —         | BCD 4-digit | ANY16                                  |
| EN      | Execution condition                                               | —         | Bit         | BOOL                                   |
| ENO     | Execution result                                                  | —         | Bit         | BOOL                                   |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the arc tangent of the value specified by (s), and store the operation result (angle) in the device specified by (d).

$$\text{TAN}^{-1} \left( \frac{(s)}{(s)+1} \cdot \frac{(s)+2}{(s)+1} \right) = (d)$$

(s): Sign

(s)+1: Integral part

(s)+2: Decimal part

- Set the sign of the calculation data in the device specified by (s). Store 0 when the calculation data is positive, or store 1 when the calculation data is negative.
- Store a BCD value for the integral part of calculation data in (s)+1 and a BCD value for the decimal part in (s)+2. (A value from 0 to 9999.9999 can be set.)
- The operation result to be stored in the device specified by (d) is a BCD value in the range from 0 to 90° or 270 to 360° (in DEG. unit).
- The operation result is a value whose decimal part is rounded off.

## Operation error

| Error code (SD0) | Description                                                 |
|------------------|-------------------------------------------------------------|
| 3285H            | The data in the device specified by (s) is not a BCD value. |

# Converting single-precision real number angle to radian

## RAD(P)

These instructions convert the unit of the measure of angle from the degree specified by a single-precision real number to radian.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | <pre>ENO:=RAD(EN,s,d); ENO:=RADP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| RAD         |                     |
| RADP        |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                                   | Range                              | Data type                    | Data type (label) |
|---------|-----------------------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Angle for which the unit is to be changed to radian, or the start device containing the angle | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the angle in radians                                                 | —                                  | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                           | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                                              | —                                  | Bit                          | BOOL              |

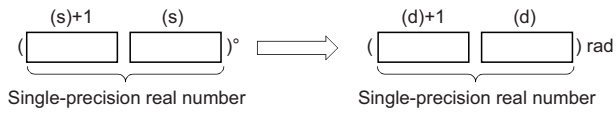
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |



## Processing details

- These instructions convert the unit of the measure of angle from the degree specified by (s) to the radian, and store the angle in radians in the device number specified by (d).



- Unit conversion from the degree to the radian is performed as follows.

$$\text{Radian} = \text{Degree} \times \frac{\pi}{180}$$

- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

 Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                            |
|------------------|--------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                 |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (d)  < 2^{128}$ |

# Converting single-precision real number radian to angle

## DEG(P)

These instructions convert the unit of the measure of angle from the radian specified by a single-precision real number to the degree.

| Ladder | ST                                      |
|--------|-----------------------------------------|
|        | ENO:=DEG(EN,s,d);<br>ENO:=DEGP(EN,s,d); |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DEG         |                     |
| DEGP        |                     |

## Setting data

## Description, range, data type

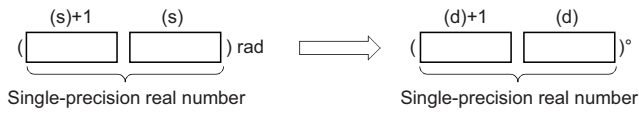
| Operand | Description                                                                                                             | Range                              | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Angle in radians for which the unit is to be changed to the degree, or the start device containing the angle in radians | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the value converted in degrees                                                                 | —                                  | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                                                     | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                                                                        | —                                  | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |      | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the unit of the measure of angle from the radian specified by (s) to the degree, and store the angle in degrees in the device number specified by (d).



- Unit conversion from the radian to the degree is performed as follows.

$$\text{Degree} = \text{Radian} \times \frac{180}{\pi}$$

- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

 Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                            |
|------------------|--------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                 |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (d)  < 2^{128}$ |

# Converting double-precision real number angle to radian

## RADD(P)

These instructions convert the unit of the measure of angle from the degree specified by a single-precision real number to radian.

| Ladder | ST                                        |
|--------|-------------------------------------------|
|        | ENO:=RADD(EN,s,d);<br>ENO:=RADDP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| RADD        |                     |
| RADDP       |                     |

### Setting data

#### Description, range, data type

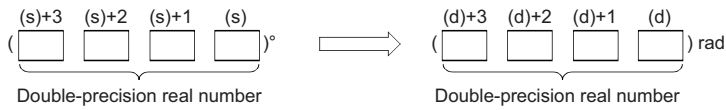
| Operand | Description                                                                                   | Range                                | Data type                    | Data type (label) |
|---------|-----------------------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Angle for which the unit is to be changed to radian, or the start device containing the angle | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the angle in radians                                                 | —                                    | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                           | —                                    | Bit                          | BOOL              |
| ENO     | Execution result                                                                              | —                                    | Bit                          | BOOL              |

#### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the unit of the measure of angle from the degree specified by (s) to the radian, and store the angle in radians in the device number specified by (d).



- Unit conversion from the degree to the radian is performed as follows.

$$\text{Radian} = \text{Degree} \times \frac{\pi}{180}$$

- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

 Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                    |
|------------------|----------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                         |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{1024}$ |

# Converting double-precision real number radian to angle

## DEGD(P)

These instructions convert the unit of the measure of angle from the radian specified by a double-precision real number to the degree.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | <pre>ENO:=DEGD(EN,s,d); ENO:=DEGDP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DEGD        |                     |
| DEGDP       |                     |

## Setting data

## Description, range, data type

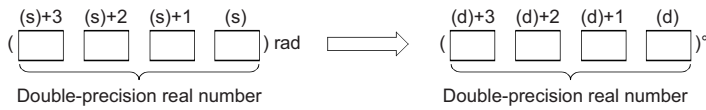
| Operand | Description                                                                                                             | Range                                | Data type                    | Data type (label) |
|---------|-------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Angle in radians for which the unit is to be changed to the degree, or the start device containing the angle in radians | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the value converted in degrees                                                                 | —                                    | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                                                     | —                                    | Bit                          | BOOL              |
| ENO     | Execution result                                                                                                        | —                                    | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions convert the unit of the measure of angle from the radian specified by (s) to the degree, and store the angle in degrees in the device number specified by (d).



- Unit conversion from the radian to the degree is performed as follows.

$$\text{Degree} = \text{Radian} \times \frac{180}{\pi}$$

- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                    |
|------------------|----------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                         |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{1024}$ |

# Calculating the square root of single-precision real number

## ESQRT(P)

These instructions calculate the square root of the value specified by a single-precision real number.

| Ladder | ST                                                  |
|--------|-----------------------------------------------------|
|        | <pre>ENO:=ESQRT(EN,s,d); ENO:=ESQRTP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ESQRT       |                     |
| ESQRTP      |                     |



## Setting data

### ■Description, range, data type

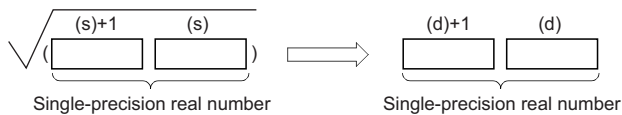
| Operand | Description                                                                  | Range                              | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Data used for square root operation, or the start device containing the data | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                | —                                  | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                          | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                             | —                                  | Bit                          | BOOL              |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the square root of the value specified by (s), and store the operation result in the device specified by (d).



- The value specified by (s) must be positive. (No negative value can be calculated.)
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

📖 Page 40 Precautions

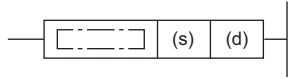
## Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |
| 3285H            | The value in the device specified by (s) is a negative number.                         |

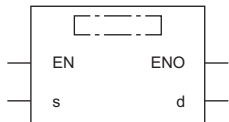
# Calculating the square root of double-precision real number

## EDSQRT(P)

These instructions calculate the square root of the value specified by a double-precision real number.

| Ladder                                                                            | ST                                                    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------|
|  | <pre>ENO:=EDSQRT(EN,s,d); ENO:=EDSQRTP(EN,s,d);</pre> |

## FBD/LD



### ■Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| EDSQRT      |  |
| EDSQRTP     |  |

## Setting data

### ■Description, range, data type

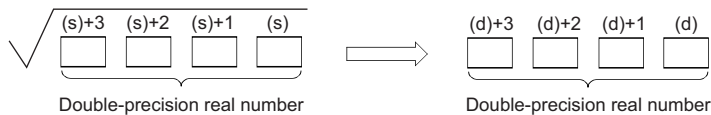
| Operand | Description                                                                  | Range                                | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Data used for square root operation, or the start device containing the data | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                | —                                    | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                          | —                                    | Bit                          | BOOL              |
| ENO     | Execution result                                                             | —                                    | Bit                          | BOOL              |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the square root of the value specified by (s), and store the operation result in the device specified by (d).



- The value specified by (s) must be positive. (No negative value can be calculated.)
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

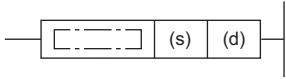
## Operation error

| Error code (SD0) | Description                                                                            |
|------------------|----------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |
| 3285H            | The value in the device specified by (s) is a negative number.                         |

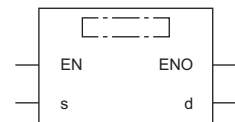
# Calculating the exponent of single-precision real number

## EXP(P)

These instructions calculate the exponent of the value specified by a single-precision real number.

| Ladder                                                                            | ST <sup>*1</sup>   |
|-----------------------------------------------------------------------------------|--------------------|
|  | ENO:=EXPP(EN,s,d); |

## FBD/LD<sup>\*1</sup>



<sup>\*1</sup> The EXP instruction does not support the ST and FBD/LD. Use the standard function, EXP.

 Page 1322 EXP(\_E)

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| EXP         |  |
| EXPP        |  |

## Setting data

## Description, range, data type

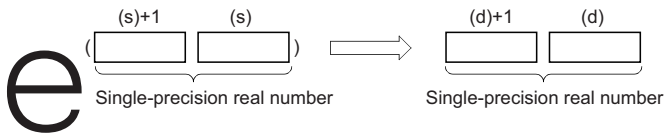
| Operand | Description                                                                  | Range                              | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Data used for exponential operation, or the start device containing the data | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                | —                                  | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                          | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                             | —                                  | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the exponent of the value specified by (s), and store the operation result in the device specified by (d).



- Exponent operation is performed with the base (e) set to "2.71828".
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

 Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                   |
|------------------|---------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                        |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{128}$ |

### Point

- The EXP(P) instruction performs operation using the natural logarithm. To determine a value using the common logarithm, determine a value by dividing the common logarithm value by 0.43429 and specify it in the device specified by (s).

$$10^X = e^{\frac{X}{0.43429}}$$

# Calculating the exponent of double-precision real number

## EXPDP(P)

These instructions calculate the exponent of the value specified by a double-precision real number.

| Ladder | ST*1                |
|--------|---------------------|
|        | ENO:=EXPDP(EN,s,d); |

| FBD/LD*1 |
|----------|
|          |

\*1 The EXPDP instruction does not support the ST and FBD/LD. Use the standard function, EXP.

Page 1322 EXP(\_E)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| EXPDP       |                     |
| EXPDP       |                     |

## Setting data

## Description, range, data type

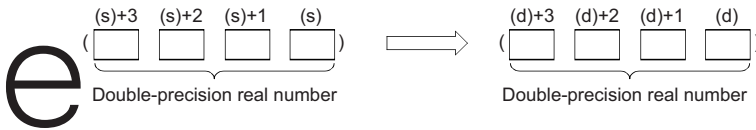
| Operand | Description                                                                  | Range                                | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Data used for exponential operation, or the start device containing the data | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                | —                                    | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                          | —                                    | Bit                          | BOOL              |
| ENO     | Execution result                                                             | —                                    | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —         | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —         | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the exponent of the value specified by (s), and store the operation result in the device specified by (d).



- Exponent operation is performed with the base (e) set to "2.71828".
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                    |
|------------------|----------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                         |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{1024}$ |

### Point

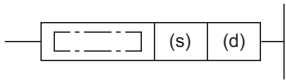
- The EXPD(P) instruction performs operation using the natural logarithm. To determine a value using the common logarithm, determine a value by dividing the common logarithm value by 0.43429 and specify it in the device specified by (s).

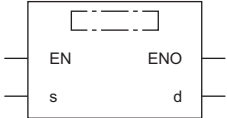
$$10^X = e^{\frac{X}{0.43429}}$$

# Calculating the natural logarithm of single-precision real number

## LOG(P)

These instructions calculate the logarithm using the natural logarithm (e) of the value specified by a single-precision real number as the base.

| Ladder                                                                            | ST <sup>*1</sup>   |
|-----------------------------------------------------------------------------------|--------------------|
|  | ENO:=LOGP(EN,s,d); |

| FBD/LD <sup>*1</sup>                                                              |
|-----------------------------------------------------------------------------------|
|  |

<sup>\*1</sup> The LOG instruction does not support the ST and FBD/LD. Use the standard function, LOG.

☞ Page 1320 LOG(\_E)

## Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| LOG         |   |
| LOGP        |  |

## Setting data

## Description, range, data type

| Operand | Description                                                                        | Range                              | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Data used for natural logarithm operation, or the start device containing the data | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                      | —                                  | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                                   | —                                  | Bit                          | BOOL              |

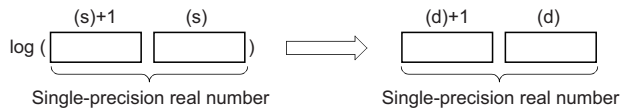
## Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |



## Processing details

- These instructions calculate the logarithm using natural logarithm (e) of the value specified by (s), and store the operation result in the device specified by (d).



- Input a positive value only. (No negative value can be calculated.)
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

 Page 40 Precautions

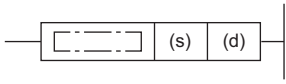
## Operation error

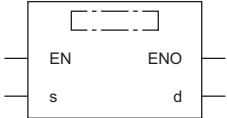
| Error code (SD0) | Description                                                                                                                                                         |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                                                              |
| 3285H            | An out-of-range value is set to (s). <ul style="list-style-type: none"> <li>The specified value is a negative number.</li> <li>The specified value is 0.</li> </ul> |

# Calculating the natural logarithm of double-precision real number

## LOGD(P)

These instructions calculate the logarithm using the natural logarithm (e) of the value specified by a double-precision real number as the base.

| Ladder                                                                            | ST <sup>*1</sup>    |
|-----------------------------------------------------------------------------------|---------------------|
|  | ENO:=LOGDP(EN,s,d); |

| FBD/LD <sup>*1</sup>                                                              |
|-----------------------------------------------------------------------------------|
|  |

<sup>\*1</sup> The LOGD instruction does not support the ST and FBD/LD. Use the standard function, LOG.

 Page 1320 LOG(\_E)

## Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| LOGD        |   |
| LOGDP       |  |

## Setting data

## Description, range, data type

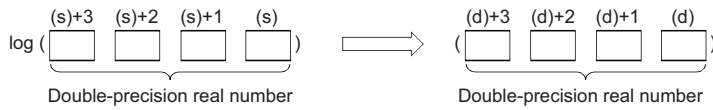
| Operand | Description                                                                        | Range                                | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Data used for natural logarithm operation, or the start device containing the data | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                      | —                                    | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                | —                                    | Bit                          | BOOL              |
| ENO     | Execution result                                                                   | —                                    | Bit                          | BOOL              |

## Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —           | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —           | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the logarithm using natural logarithm (e) of the value specified by (s), and store the operation result in the device specified by (d).



- Input a positive value only. (No negative value can be calculated.)
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

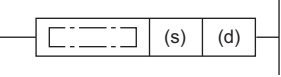
## Operation error

| Error code (SD0) | Description                                                                                                                                                         |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                                                              |
| 3285H            | An out-of-range value is set to (s). <ul style="list-style-type: none"> <li>The specified value is a negative number.</li> <li>The specified value is 0.</li> </ul> |

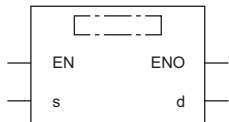
# Calculating the square root of BCD 4-digit data

## BSQRT(P)

These instructions calculate the square root of the value specified by a BCD 4-digit data.

| Ladder                                                                            | ST                                          |
|-----------------------------------------------------------------------------------|---------------------------------------------|
|  | ENO:=BSQRT(EN,s,d);<br>ENO:=BSQRTP(EN,s,d); |

## FBD/LD



### ■Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| BSQRT       |  |
| BSQRTP      |  |

## Setting data

### ■Descriptions, ranges, and data types

| Operand | Description                                                            | Range     | Data type   | Data type (label)                      |
|---------|------------------------------------------------------------------------|-----------|-------------|----------------------------------------|
| (s)     | Data used for square root operation, or the device containing the data | 0 to 9999 | BCD 4-digit | ANY16                                  |
| (d)     | Start device for storing the operation result                          | —         | BCD 4-digit | ANY16_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                    | —         | Bit         | BOOL                                   |
| ENO     | Execution result                                                       | —         | Bit         | BOOL                                   |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the square root of the BCD 4-digit data specified by (s), and store the operation result in the device specified by (d).

$$\sqrt{\boxed{(s)}} = \boxed{(d)}.\boxed{(d)+1}$$

(d): Integral part

(d)+1: Decimal part

- The value to be specified in (s) is a BCD value with a maximum of 4 digits (0 to 9999).
- A BCD value from 0 to 9999.9999 is stored as the operation result in the device specified by (d).
- The operation result is a value whose 5th decimal place is rounded down.

## Operation error

| Error code (SD0) | Description                                                 |
|------------------|-------------------------------------------------------------|
| 3285H            | The data in the device specified by (s) is not a BCD value. |

# Calculating the square root of BCD 8-digit data

## BDSQRT(P)

These instructions calculate the square root of the value specified by a BCD 8-digit data.

| Ladder | ST                                                   |
|--------|------------------------------------------------------|
|        | <pre>ENO:=BDSQRT(EN,s,d); ENO:=BDSQRT(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction    | Execution condition |
|----------------|---------------------|
| BDSQRT         |                     |
| BDSQRT(EN,s,d) |                     |

## Setting data

### ■Description, range, data type

| Operand | Description                                                                  | Range         | Data type   | Data type (label)                      |
|---------|------------------------------------------------------------------------------|---------------|-------------|----------------------------------------|
| (s)     | Data used for square root operation, or the start device containing the data | 0 to 99999999 | BCD 8-digit | ANY32                                  |
| (d)     | Start device for storing the operation result                                | —             | BCD 4-digit | ANY16_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                          | —             | Bit         | BOOL                                   |
| ENO     | Execution result                                                             | —             | Bit         | BOOL                                   |

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the square root of the BCD 8-digit data specified by (s), and store the operation result in the device specified by (d).

$$\sqrt{\left( \begin{array}{|c|c|} \hline (s)+1 & (s) \\ \hline \end{array} \right)} = \begin{array}{|c|} \hline (d) \\ \hline \end{array} . \begin{array}{|c|} \hline (d)+1 \\ \hline \end{array}$$

(s)+1, (s): 2-word data

(d): Integral part

(d)+1: Decimal part

- The value to be specified in (s) is a BCD value with a maximum of 8 digits (0 to 99999999).
- A BCD value from 0 to 9999.9999 is stored as the operation result in the device specified by (d).
- The operation result is a value whose 5th decimal place is rounded down.

## Operation error

| Error code (SD0) | Description                                                 |
|------------------|-------------------------------------------------------------|
| 3285H            | The data in the device specified by (s) is not a BCD value. |

# Calculating the exponentiation of single-precision real number

## POW(P)

These instructions calculate the exponentiation of a single-precision real number.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | ENO:=POW(EN,s1,s2,d);<br>ENO:=POWP(EN,s1,s2,d); |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| POW         |                     |
| POWP        |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                                    | Range                               | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------------------------|-------------------------------------|------------------------------|-------------------|
| (s1)    | Exponentiation recipient data or the start device containing the exponentiation recipient data | $0, 2^{-126} \leq  (s1)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (s2)    | Exponentiation data or the start device containing the data                                    | $0, 2^{-126} \leq  (s2)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                                  | —                                   | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                                            | —                                   | Bit                          | BOOL              |
| ENO     | Execution result                                                                               | —                                   | Bit                          | BOOL              |

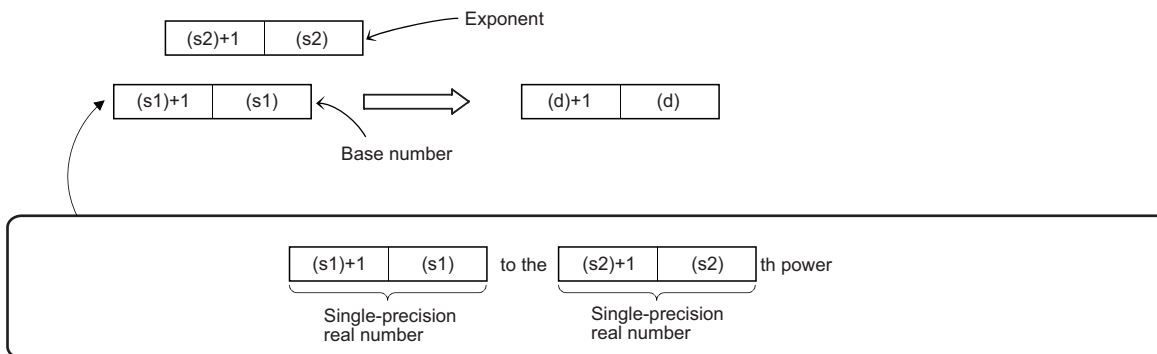
## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |



## Processing details

- These instructions raises the single-precision real number specified by (s1) to the power of the single-precision real number specified by (s2), and store the operation result in the device specified by (d).



- The values that can be specified by (s1) and (s2) and the value that can be stored are  $0, 2^{-126} \leq |\text{setting value (stored value)}| < 2^{128}$ .
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                           |
|------------------|-----------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) or (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                       |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ (d)  < 2^{128}$ |

# Calculating the exponentiation of double-precision real number

## POWD(P)

These instructions calculate the exponentiation of a double-precision real number.

| Ladder | ST                                                |
|--------|---------------------------------------------------|
|        | ENO:=POWD(EN,s1,s2,d);<br>ENO:=POWDP(EN,s1,s2,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| POWD        |                     |
| POWDP       |                     |

### Setting data

### Description, range, data type

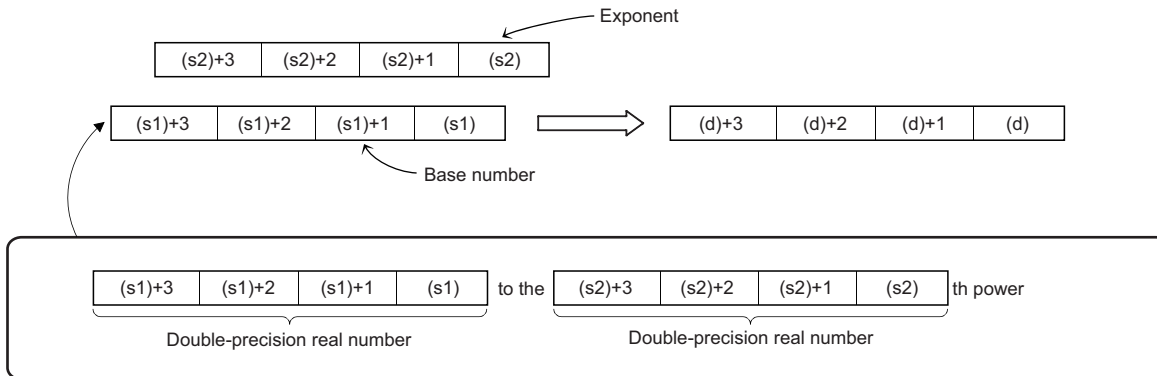
| Operand | Description                                                                                    | Range                                 | Data type                    | Data type (label) |
|---------|------------------------------------------------------------------------------------------------|---------------------------------------|------------------------------|-------------------|
| (s1)    | Exponentiation recipient data or the start device containing the exponentiation recipient data | $0, 2^{-1022} \leq  (s1)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (s2)    | Exponentiation data or the start device containing the data                                    | $0, 2^{-1022} \leq  (s2)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                                  | —                                     | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                                            | —                                     | Bit                          | BOOL              |
| ENO     | Execution result                                                                               | —                                     | Bit                          | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (s2)    | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions raises the double-precision real number specified by (s1) to the power of the double-precision real number specified by (s2), and store the operation result in the device specified by (d).



- The values that can be specified by (s1) and (s2) and the value that can be stored are  $0, 2^{-1022} \leq |\text{setting value (stored value)}| < 2^{1024}$ .
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

Page 40 Precautions

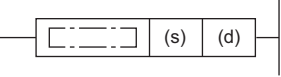
## Operation error

| Error code (SD0) | Description                                                                                                                   |
|------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) or (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                               |
| 3283H            | The data in the device specified by (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{1024}$ |

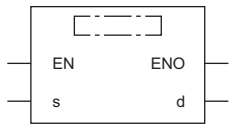
# Calculating the common logarithm of single-precision real number

## LOG10(P)

These instructions calculate the logarithm using the common logarithm (using 10 as the base) of the value specified by a single-precision real number.

| Ladder                                                                            | ST                                                  |
|-----------------------------------------------------------------------------------|-----------------------------------------------------|
|  | <pre>ENO:=LOG10(EN,s,d); ENO:=LOG10P(EN,s,d);</pre> |

## FBD/LD



### ■Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| LOG10       |   |
| LOG10P      |  |

## Setting data

### ■Description, range, data type

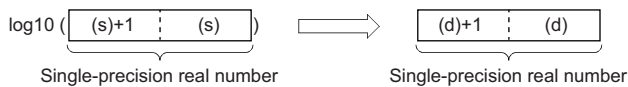
| Operand | Description                                                                       | Range                              | Data type                    | Data type (label) |
|---------|-----------------------------------------------------------------------------------|------------------------------------|------------------------------|-------------------|
| (s)     | Data used for common logarithm operation, or the start device containing the data | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32        |
| (d)     | Start device for storing the operation result                                     | —                                  | Single-precision real number | ANYREAL_32        |
| EN      | Execution condition                                                               | —                                  | Bit                          | BOOL              |
| ENO     | Execution result                                                                  | —                                  | Bit                          | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | ○          | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the common logarithm (using 10 as the base) of the value specified by (s), and store the operation result in the device number specified by (d).



- The value specified by (s) must be positive. (No negative value can be calculated.)
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

## Operation error

| Error code (SD0) | Description                                                                                                                                                         |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                                                              |
| 3285H            | An out-of-range value is set to (s). <ul style="list-style-type: none"> <li>The specified value is a negative number.</li> <li>The specified value is 0.</li> </ul> |

# Calculating the common logarithm of double-precision real number

## LOG10D(P)

These instructions calculate the logarithm using the common logarithm (using 10 as the base) of the value specified by a double-precision real number.

| Ladder | ST                                            |
|--------|-----------------------------------------------|
|        | ENO:=LOG10D(EN,s,d);<br>ENO:=LOG10DP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| LOG10D      |                     |
| LOG10DP     |                     |

## Setting data

### ■Description, range, data type

| Operand | Description                                                                       | Range                                | Data type                    | Data type (label) |
|---------|-----------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------|
| (s)     | Data used for common logarithm operation, or the start device containing the data | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64        |
| (d)     | Start device for storing the operation result                                     | —                                    | Double-precision real number | ANYREAL_64        |
| EN      | Execution condition                                                               | —                                    | Bit                          | BOOL              |
| ENO     | Execution result                                                                  | —                                    | Bit                          | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | ○ | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions calculate the common logarithm (using 10 as the base) of the value specified by (s), and store the operation result in the device number specified by (d).

$$\log_{10} \left( \underbrace{\left( (s)+3 \frac{1}{10} (s)+2 \frac{1}{10} (s)+1 \frac{1}{10} (s) \right)}_{\text{Double-precision real number}} \right) \longrightarrow \underbrace{\left( (d)+3 \frac{1}{10} (d)+2 \frac{1}{10} (d)+1 \frac{1}{10} (d) \right)}_{\text{Double-precision real number}}$$

- The value specified by (s) must be positive. (No negative value can be calculated.)
- If the operation result is -0 or an underflow occurs, the operation result turns out to 0.
- When an input value is set using the engineering tool, a rounding error may occur. Refer to the following for the precautions on setting input values using the engineering tool.

☞ Page 40 Precautions

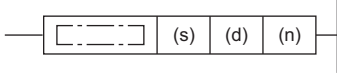
## Operation error

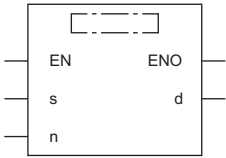
| Error code (SD0) | Description                                                                                                                                                         |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                                                              |
| 3285H            | An out-of-range value is set to (s). <ul style="list-style-type: none"> <li>The specified value is a negative number.</li> <li>The specified value is 0.</li> </ul> |

# Searching the maximum value of single-precision real number

## EMAX(P)

These instructions search the block data of single-precision real numbers for the maximum value.

| Ladder                                                                            | ST <sup>*1</sup>      |
|-----------------------------------------------------------------------------------|-----------------------|
|  | ENO:=EMAXP(EN,s,n,d); |

| FBD/LD <sup>*1</sup>                                                              |
|-----------------------------------------------------------------------------------|
|  |

<sup>\*1</sup> The EMAX instruction does not support the ST and FBD/LD. Use the standard function, MAX.

☞ Page 1360 MAX(\_E), MIN(\_E)

## Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| EMAX        |   |
| EMAXP       |  |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                                                                                                    | Range                              | Data type                    | Data type (label)                      |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------|----------------------------------------|
| (s)     | Single-precision real number used for maximum value search, or the start device containing single-precision real numbers                       | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32 <sup>*1</sup>               |
| (d)     | Start device for storing the search result<br>(d) to (d)+1: Maximum value<br>(d)+2: Position<br>(d)+3: The number of search target data points | —                                  | Single-precision real number | — <sup>*2</sup><br>(ANY_REAL_32_ARRAY) |
| (n)     | Number of single-precision real number block data points                                                                                       | 0 to 65535                         | 16-bit unsigned binary       | ANY16                                  |
| EN      | Execution condition                                                                                                                            | —                                  | Bit                          | BOOL                                   |
| ENO     | Execution result                                                                                                                               | —                                  | Bit                          | BOOL                                   |

<sup>\*1</sup> When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

<sup>\*2</sup> Specify a device regardless of the programming language used. Do not specify labels.

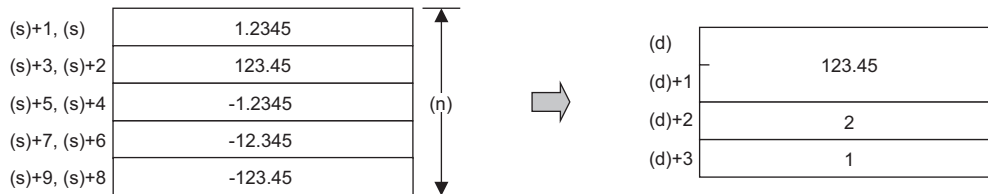
## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |



## Processing details

- These instructions search for the maximum value in the (n) points of single-precision real number block data in the device starting from the one specified by (s), and store the maximum value in the device specified by (d). The instructions store the location of the first maximum value by the number of points from (s) in the device specified by (d)+2 and the number of maximum values in the device specified by (d)+3.
- The start of the block data in the device specified by (s) is counted as the 1st point when the search result (location) is counted.



(d), (d)+1: Maximum value  
 (d)+2: Location  
 (d)+3: Number of maximum values

- When (n) is 0, the processing is not performed.

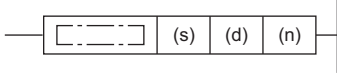
## Operation error

| Error code<br>(SD0) | Description                                                                                             |
|---------------------|---------------------------------------------------------------------------------------------------------|
| 3282H               | The block data in the device specified by (s) includes a value other than single-precision real number. |

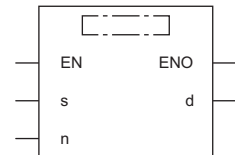
# Searching the maximum value of double-precision real number

## EDMAX(P)

These instructions search the block data of double-precision real numbers for the maximum value.

| Ladder                                                                            | ST <sup>*1</sup>       |
|-----------------------------------------------------------------------------------|------------------------|
|  | ENO:=EDMAXP(EN,s,n,d); |

## FBD/LD<sup>\*1</sup>



<sup>\*1</sup> The EDMAX instruction does not support the ST and FBD/LD. Use the standard function, MAX.

☞ Page 1360 MAX(\_E), MIN(\_E)

## Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| EDMAX       |   |
| EDMAXP      |  |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                                                                                                    | Range                                | Data type                    | Data type (label)                       |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------------|-----------------------------------------|
| (s)     | Double-precision real number used for maximum value search, or the start device containing double-precision real numbers                       | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64 <sup>*1</sup>                |
| (d)     | Start device for storing the search result<br>(d) to (d)+3: Maximum value<br>(d)+4: Position<br>(d)+5: The number of search target data points | —                                    | Double-precision real number | __ <sup>*2</sup><br>(ANY_REAL_64_ARRAY) |
| (n)     | Number of double-precision real number block data points                                                                                       | 0 to 65535                           | 16-bit unsigned binary       | ANY16                                   |
| EN      | Execution condition                                                                                                                            | —                                    | Bit                          | BOOL                                    |
| ENO     | Execution result                                                                                                                               | —                                    | Bit                          | BOOL                                    |

<sup>\*1</sup> When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

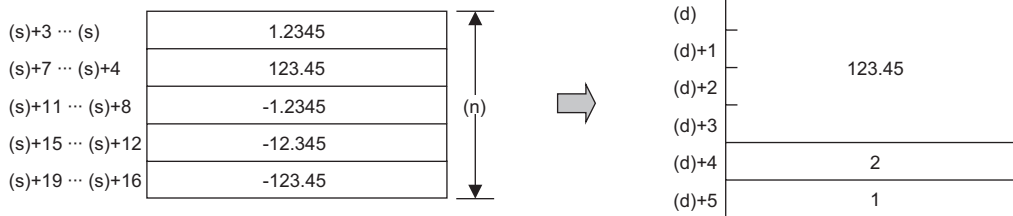
<sup>\*2</sup> Specify a device regardless of the programming language used. Do not specify labels.

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions search for the maximum value in the (n) points of double-precision real number block data in the device starting from the one specified by (s), and store the maximum value in the device specified by (d). The instructions store the location of the first maximum value by the number of points from (s) in the device specified by (d)+4 and the number of maximum values in the device specified by (d)+5.
- The start of the block data in the device specified by (s) is counted as the 1st point when the search result (location) is counted.



(d), (d)+1, (d)+2, (d)+3: Maximum value

(d)+4: Location

(d)+5: Number of maximum values

- When (n) is 0, the processing is not performed.

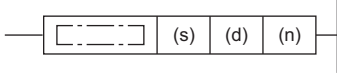
## Operation error

| Error code (SD0) | Description                                                                                             |
|------------------|---------------------------------------------------------------------------------------------------------|
| 3282H            | The block data in the device specified by (s) includes a value other than double-precision real number. |

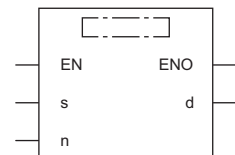
# Searching the minimum value of single-precision real number

## EMIN(P)

These instructions search the block data of single-precision real numbers for the minimum value.

| Ladder                                                                            | ST <sup>*1</sup>      |
|-----------------------------------------------------------------------------------|-----------------------|
|  | ENO:=EMINP(EN,s,n,d); |

## FBD/LD<sup>\*1</sup>



<sup>\*1</sup> The EMIN instruction does not support the ST and FBD/LD. Use the standard function, MIN.

☞ Page 1360 MAX(\_E), MIN(\_E)

## Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| EMIN        |   |
| EMINP       |  |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                                                                                                    | Range                              | Data type                    | Data type (label)                        |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------|------------------------------------------|
| (s)     | Single-precision real number used for minimum value search, or the start device containing single-precision real numbers                       | $0, 2^{-126} \leq  (s)  < 2^{128}$ | Single-precision real number | ANYREAL_32 <sup>*1</sup>                 |
| (d)     | Start device for storing the search result<br>(d) to (d)+1: Minimum value<br>(d)+2: Position<br>(d)+3: The number of search target data points | —                                  | Single-precision real number | ___ <sup>*2</sup><br>(ANY_REAL_32_ARRAY) |
| (n)     | Number of single-precision real number block data points                                                                                       | 0 to 65535                         | 16-bit unsigned binary       | ANY16                                    |
| EN      | Execution condition                                                                                                                            | —                                  | Bit                          | BOOL                                     |
| ENO     | Execution result                                                                                                                               | —                                  | Bit                          | BOOL                                     |

<sup>\*1</sup> When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

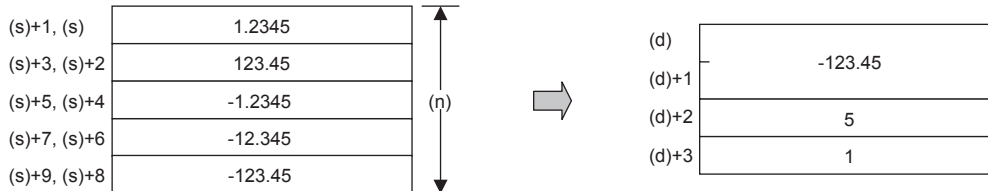
<sup>\*2</sup> Specify a device regardless of the programming language used. Do not specify labels.

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions search for the minimum value in the (n) points of single-precision real number block data in the device starting from the one specified by (s), and store the maximum value in the device specified by (d). The instructions store the location of the first minimum value by the number of points from (s) in the device specified by (d)+2 and the number of minimum values in the device specified by (d)+3.
- The start of the block data in the device specified by (s) is counted as the 1st point when the search result (location) is counted.



(d), (d)+1: Minimum value

(d)+2: Location

(d)+3: Number of minimum values

- When (n) is 0, the processing is not performed.

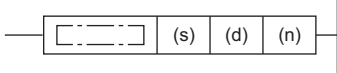
## Operation error

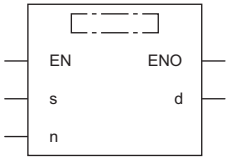
| Error code<br>(SD0) | Description                                                                                             |
|---------------------|---------------------------------------------------------------------------------------------------------|
| 3282H               | The block data in the device specified by (s) includes a value other than single-precision real number. |

# Searching the minimum value of double-precision real number

## EDMIN(P)

These instructions search the block data of double-precision real numbers for the minimum value.

| Ladder                                                                            | ST <sup>*1</sup>       |
|-----------------------------------------------------------------------------------|------------------------|
|  | ENO:=EDMINP(EN,s,n,d); |

| FBD/LD <sup>*1</sup>                                                              |
|-----------------------------------------------------------------------------------|
|  |

<sup>\*1</sup> The EDMIN instruction does not support the ST and FBD/LD. Use the standard function, MIN.

☞ Page 1360 MAX(\_E), MIN(\_E)

## Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| EDMIN       |   |
| EDMINP      |  |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                                                                                                    | Range                                | Data type                    | Data type (label)                        |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------------|------------------------------------------|
| (s)     | Double-precision real number used for minimum value search, or the start device containing double-precision real numbers                       | $0, 2^{-1022} \leq  (s)  < 2^{1024}$ | Double-precision real number | ANYREAL_64 <sup>*1</sup>                 |
| (d)     | Start device for storing the search result<br>(d) to (d)+3: Minimum value<br>(d)+4: Position<br>(d)+5: The number of search target data points | —                                    | Double-precision real number | ___ <sup>*2</sup><br>(ANY_REAL_64_ARRAY) |
| (n)     | Number of double-precision real number block data points                                                                                       | 0 to 65535                           | 16-bit unsigned binary       | ANY16                                    |
| EN      | Execution condition                                                                                                                            | —                                    | Bit                          | BOOL                                     |
| ENO     | Execution result                                                                                                                               | —                                    | Bit                          | BOOL                                     |

<sup>\*1</sup> When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

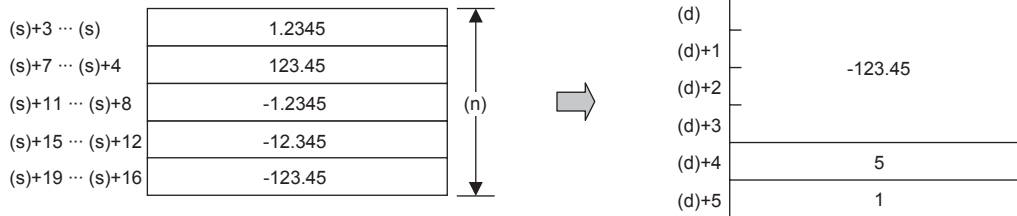
<sup>\*2</sup> Specify a device regardless of the programming language used. Do not specify labels.

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions search for the minimum value in the (n) points of double-precision real number block data in the device starting from the one specified by (s), and store the maximum value in the device specified by (d). The instructions store the location of the first minimum value by the number of points from (s) in the device specified by (d)+4 and the number of minimum values in the device specified by (d)+5.
- The start of the block data in the device specified by (s) is counted as the 1st point when the search result (location) is counted.



(d), (d)+1, (d)+2, (d)+3: Minimum value  
 (d)+4: Location  
 (d)+5: Number of minimum values

- When (n) is 0, the processing is not performed.

## Operation error

| Error code (SD0) | Description                                                                                             |
|------------------|---------------------------------------------------------------------------------------------------------|
| 3282H            | The block data in the device specified by (s) includes a value other than double-precision real number. |

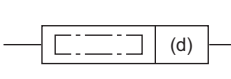
# 18 RANDOM NUMBER

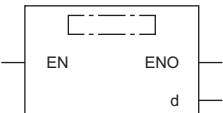
## 18.1 Random Number Instructions

### Generating random number

#### RND(P)

These instructions generate a random number between 0 and less than 32767, and store the random number in the specified device.

| Ladder                                                                            | ST                                  |
|-----------------------------------------------------------------------------------|-------------------------------------|
|  | ENO:=RND(EN,d);<br>ENO:=RNDP(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

#### ■Execution condition

| Instruction | Execution condition                                                                 |
|-------------|-------------------------------------------------------------------------------------|
| RND         |  |
| RNDP        |  |

#### Setting data

#### ■Description, range, data type

| Operand | Description                          | Range | Data type            | Data type (label) |
|---------|--------------------------------------|-------|----------------------|-------------------|
| (d)     | Device for storing the random number | —     | 16-bit signed binary | ANY16             |
| EN      | Execution condition                  | —     | Bit                  | BOOL              |
| ENO     | Execution result                     | —     | Bit                  | BOOL              |

#### ■Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (d)     | ○                                | ○   | ○                                     | ○         | ○ | —           | —  | ○                      | —        | — | —  | — |        |

#### Processing details

These instructions generate a random number between 0 and 32767, and store the random number in the device specified by (d). The RND(P) instruction generates random numbers according to a certain calculation expression. The calculation expression uses the previous calculation result as a coefficient.

#### Operation error

There is no operation error.



## Changing random sequence

### SRND(P)

These instructions change the random number sequence according to the content of the 16-bit binary data stored in the specified device.

| Ladder | ST                                            |
|--------|-----------------------------------------------|
|        | <pre>ENO:=SRND(EN,s); ENO:=SRNDP(EN,s);</pre> |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SRND        |                     |
| SRNDP       |                     |

### Setting data

### ■Description, range, data type

| Operand | Description                 | Range           | Data type            | Data type (label) |
|---------|-----------------------------|-----------------|----------------------|-------------------|
| (s)     | Random number sequence data | -32768 to 32767 | 16-bit signed binary | ANY16             |
| EN      | Execution condition         | —               | Bit                  | BOOL              |
| ENO     | Execution result            | —               | Bit                  | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            | Z | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

### Processing details

These instructions change the random number sequence according to the content of the 16-bit binary data stored in the device specified by (s). The SRND(P) instruction can change the random number calculation pattern.

### Operation error

There is no operation error.

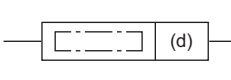
# 19 DEVICE OPERATION

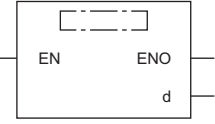
## 19.1 Index Register Instructions

### Saving all data of the index register

#### ZPUSH(P)

These instructions save the content of the index register to the specified area.

| Ladder                                                                            | ST                                       |
|-----------------------------------------------------------------------------------|------------------------------------------|
|  | ENO:=ZPUSH(EN,d);<br>ENO:=ZPUSHHP(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

#### ■Execution condition

| Instruction | Execution condition                                                                 |
|-------------|-------------------------------------------------------------------------------------|
| ZPUSH       |  |
| ZPUSHHP     |  |

#### Setting data

#### ■Description, range, data type

| Operand | Description                                            | Range | Data type            | Data type (label)   |
|---------|--------------------------------------------------------|-------|----------------------|---------------------|
| (d)     | Start device to which the index register will be saved | —     | 16-bit signed binary | ANY16 <sup>*1</sup> |
| EN      | Execution condition                                    | —     | Bit                  | BOOL                |
| ENO     | Execution result                                       | —     | Bit                  | BOOL                |

\*1 When specifying data with a label, define the array so that an area required for operation can be secured, and specify the array label element.

#### ■Applicable devices

| Operand | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions save the contents of the index register, long index register, local index register, and local long index register in the device specified by (d) or the array label element and later. The local index register and local long index register to be saved are the local index register and local long index register of the program that executed the ZPUSH instruction.
- When the content of the index register is saved, the number of saves (d) is incremented by 1.
- Regardless of the number of points assigned
- to the index register, long index register, local index register and local long index register, 48 words of data are saved.
- The ZPOP(P) instructions can be used to restore data. The ZPUSH(P) and ZPOP(P) instructions are used in pairs and can be nested to be used as a stack.

### Page 947 ZPOP(P)

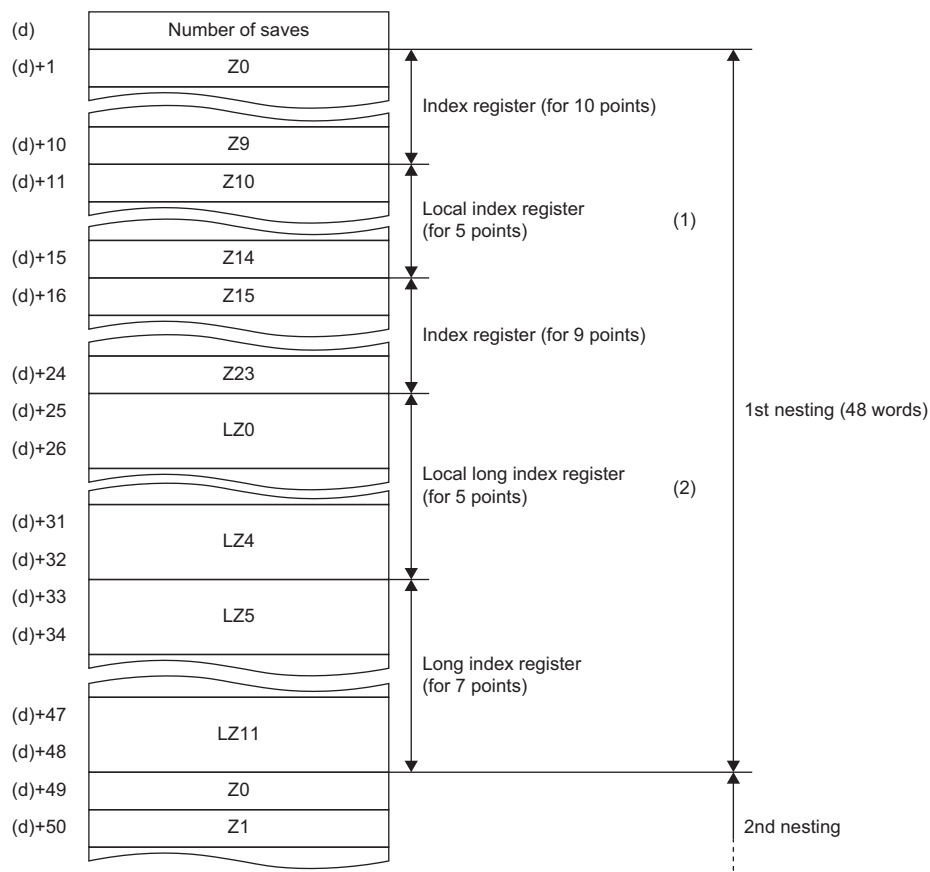
- A nesting structure can be created by specifying the area specified by (d) of the ZPUSH(P) instruction in (d) of the ZPUSH(P) instruction again. The number of saves (d) is incremented by 1 every time the ZPUSH(P) instruction is executed.
- When another area is specified in (d) of the ZPUSH(P) instruction in the nesting structure, the content of the index register is saved to the specified another area.
- In the nesting structure, every time the ZPUSH(P) instruction is executed, saved data is added. Therefore, secure in advance the areas necessary for the number of times the instruction is executed.

**Ex.**

When the local setting of the index register setting is set as follows in the engineering tool, the following figure shows the configuration of the areas used after (d).

[CPU Parameter] ⇒ [Memory/Device Setting] ⇒ [Index Register Setting]

| Item          |                          |                                | Set value |
|---------------|--------------------------|--------------------------------|-----------|
| Local setting | Number of points setting | Local Index register (Z)       | 5 points  |
|               |                          | Local long index register (LZ) | 5 points  |
|               | Start                    | Index register (Z)             | 10        |
|               |                          | Long index register (LZ)       | 0         |



(1) Save the local index register for 5 points from Z10.

(2) Save the local long index register for 5 points from LZ0.

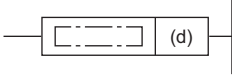
## Operation error

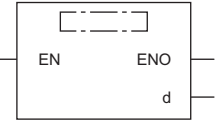
| Error code (SD0) | Description                           |
|------------------|---------------------------------------|
| 3285H            | The number of saves in (d)+0 is FFFF. |

## Returning all data of the index register

### ZPOP(P)

These instructions read the data, which has been saved to the specified area, into the index register.

| Ladder                                                                            | ST                                    |
|-----------------------------------------------------------------------------------|---------------------------------------|
|  | ENO:=ZPOP(EN,d);<br>ENO:=ZPOPP(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| ZPOP        |  |
| ZPOPP       |  |

### Setting data

### Description, range, data type

| Operand | Description                                               | Range | Data type            | Data type (label)   |
|---------|-----------------------------------------------------------|-------|----------------------|---------------------|
| (d)     | Start device to which the index register will be restored | —     | 16-bit signed binary | ANY16 <sup>*1</sup> |
| EN      | Execution condition                                       | —     | Bit                  | BOOL                |
| ENO     | Execution result                                          | —     | Bit                  | BOOL                |

\*1 When specifying data with a label, define the array so that an area required for operation can be secured, and specify the array label element.

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

### Processing details

- These instructions read the data, which has been saved to the device specified by (d) or the array label element and later, into the index register, long index register, local index register, and local long index register.
- When the content of the index register is read, the number of saves (d) is decremented by 1.
- The local index register and local long index register to be restored are the local index register and local long index register of the program that executed the ZPOP instruction.
- Refer to the following for the configuration of the areas used after (d).

📖 Page 944 ZPUSH(P)

### Operation error

| Error code (SD0) | Description                        |
|------------------|------------------------------------|
| 3285H            | The number of saves in (d)+0 is 0. |

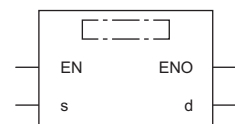
# Saving the selected data of the index register and long index register

## ZPUSH(P)

These instruction save the contents of the index register and long index register to the specified area.

| Ladder | ST                                             |
|--------|------------------------------------------------|
|        | ENO:=ZPUSH_2(EN,s,d);<br>ENO:=ZPUSH_2(EN,s,d); |

## FBD/LD



(□ is replaced by ZPUSH\_2 or ZPUSH\_2.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ZPUSH       |                     |
| ZPUSHP      |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                                    | Range  | Data type              | Data type (label)   |
|---------|--------------------------------------------------------------------------------|--------|------------------------|---------------------|
| (s)     | Type of the index register and long index register to be saved                 | 1 to 3 | 16-bit unsigned binary | ANY16               |
| (d)     | Start device to which the index register and long index register will be saved | —      | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| EN      | Execution condition                                                            | —      | Bit                    | BOOL                |
| ENO     | Execution result                                                               | —      | Bit                    | BOOL                |

<sup>\*1</sup> When specifying data with a label, define the array so that an area required for operation can be secured, and specify the array label element.

## Applicable devices

| Operand | Bit                              |      | Word                                  |                 |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-----------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□     | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | —    | ○                                     | ○ <sup>*1</sup> | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —               | — | —           | —  | ○                      | —        | — | —  | —      |

<sup>\*1</sup> Only U3E□\G□ can be used.

## Processing details

- These instructions save the index register, long index register, local index register, and local long index register to be saved in the device specified by (d) or the array label element and later.
- When the contents of the index register, long index register, local index register and local long index register are saved, the number of saves (d) is incremented by 1.
- The local index register and local long index register to be saved are the local index register and local long index register of the program that executed the ZPUSH instruction.
- The type of the index register, long index register, local index register and local long index register to be saved are stored to the end of the saved data.
- The following table lists the values specified by (s), and the index register, long index register, local index register, and local long index register to be saved.

| Value of (s) | Z and LZ saved          |
|--------------|-------------------------|
| 1            | Total range of Z and LZ |
| 2            | Total range of Z        |
| 3            | Total range of LZ       |

- The ZPOP(P) instructions (restoring the selected data of the index register and long index register) are used to restore data. The ZPUSH(P) and ZPOP(P) instructions are used in pairs and can be nested to be used as a stack.

### Page 952 ZPOP(P)

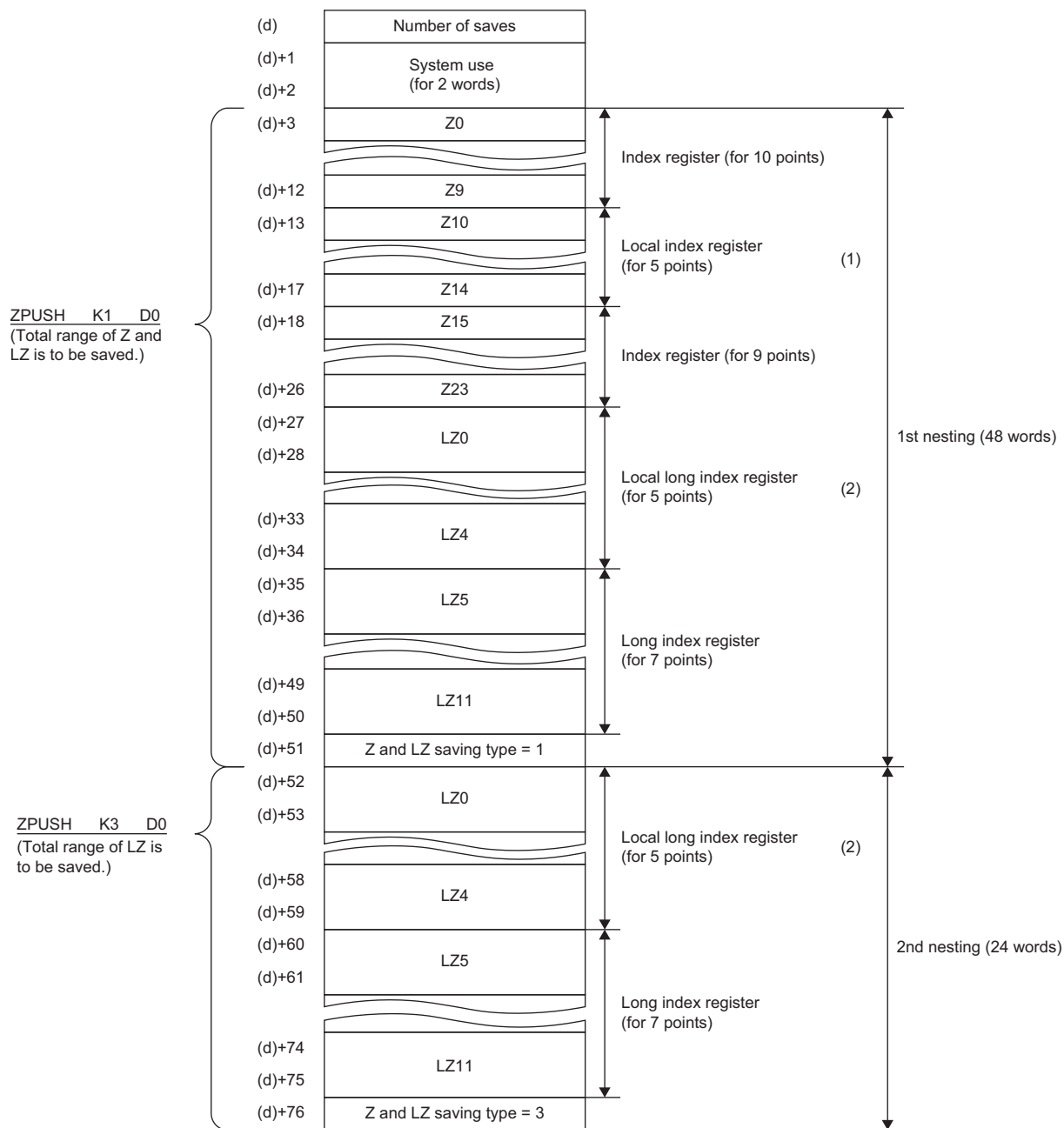
- A nesting structure can be created by specifying the area specified by (d) of the ZPUSH(P) instruction in (d) of the ZPUSH(P) instruction again. The number of saves (d) is incremented by 1 every time the ZPUSH(P) instruction is executed.
- When another area is specified in (d) of the ZPUSH(P) instruction in the nesting structure, the content of the index register or long index register is saved to the specified another area.
- In the nesting structure, every time the ZPUSH(P) instruction is executed, saved data is added. Therefore, check the numbers of points assigned to the index register and long index register according to SD300 and SD302, and secure in advance the areas necessary for the number of times the instruction is executed.

**Ex.**

When the local setting of the index register setting is set as follows in the engineering tool, the following figure shows the configuration of the areas used after (d).

[CPU Parameter] ⇒ [Memory/Device Setting] ⇒ [Index Register Setting]

| Item          |                          |                                | Set value |
|---------------|--------------------------|--------------------------------|-----------|
| Local setting | Number of points setting | Local Index register (Z)       | 5 points  |
|               |                          | Local long index register (LZ) | 5 points  |
|               | Start                    | Index register (Z)             | 10        |
|               |                          | Long index register (LZ)       | 0         |



(1) Save the local index register for 5 points from Z10.

(2) Save the local long index register for 5 points from LZ0.



## Precautions

(d)+1 and (d)+2 for the ZPUSH(P) instructions are used for the system. Do not change the values.

The Z and LZ save types stored in the area specified by (d) and later are also used for the system. Do not change the values.

Changing the values may cause malfunction of the module.

## Operation error

| Error code<br>(SD0) | Description                                                                                 |
|---------------------|---------------------------------------------------------------------------------------------|
| 3285H               | An out-of-range value is set to (s).                                                        |
|                     | The specified value is other than 1 to 3.                                                   |
|                     | The value stored in the system-reserved area in the area specified by (d) has been changed. |
|                     | The number of saves in (d) is FFFF.                                                         |

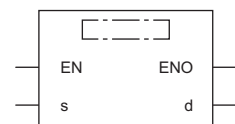
# Returning the selected data of the index register and long index register

## ZPOP(P)

These instructions read the data, which has been saved to the specified area, into the index register and long index register.

| Ladder | ST                                            |
|--------|-----------------------------------------------|
|        | ENO:=ZPOP_2(EN,s,d);<br>ENO:=ZPOPP_2(EN,s,d); |

## FBD/LD



(□ is replaced by ZPOP\_2 or ZPOPP\_2.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ZPOP        |                     |
| ZPOPP       |                     |

## Setting data

## Description, range, data type

| Operand | Description                                               | Range | Data type              | Data type (label)   |
|---------|-----------------------------------------------------------|-------|------------------------|---------------------|
| (s)     | Dummy                                                     | —     | 16-bit unsigned binary | ANY16               |
| (d)     | Start device to which the index register will be restored | —     | 16-bit signed binary   | ANY16 <sup>*1</sup> |
| EN      | Execution condition                                       | —     | Bit                    | BOOL                |
| ENO     | Execution result                                          | —     | Bit                    | BOOL                |

\*1 When specifying data with a label, define the array so that an area required for operation can be secured, and specify the array label element.

## Applicable devices

| Operand | Bit                              |     | Word                                  |                 | Z | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-----------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□      |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | —   | ○                                     | ○ <sup>*1</sup> | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —               | — | —           | —  | ○                      | —        | — | —  | —      |

\*1 Only U3E□\G□ can be used.

## Processing details

- These instructions read the data, which has been saved to the device specified by (d) or the array label element and later, into the index register, long index register, local index register, and local long index register.
- When the data saved to the index register and long index register is read, the number of saves (d) is decremented by 1.
- The local index register and local long index register to be restored are the local index register and local long index register of the program that executed the ZPOP instruction.
- The date data in the device specified by (s) is regarded as dummy data and ignored.
- Refer to the following for the configuration of the areas used after (d).

Page 948 ZPUSH(P)

## Precautions

(d)+1 and (d)+2 are used for the system. Do not change the values.

The Z and LZ save types stored in the area specified by (d) and later are also used for the system. Do not change the values.

Changing the values may cause malfunction of the module.

## Operation error

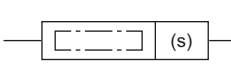
| Error code<br>(SD0) | Description                                                                                 |
|---------------------|---------------------------------------------------------------------------------------------|
| 3285H               | The number of saves in (d)+0 is 0.                                                          |
|                     | The value stored in the system-reserved area in the area specified by (d) has been changed. |
|                     | A value other than 1 to 3 is set to the Z, LZ save type.                                    |

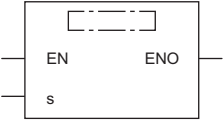
# 19.2 File Register Operation Instructions

## Switching the file register block number

### RSET(P)

These instructions change the block number of the file register used in the program.

| Ladder                                                                            | ST                                    |
|-----------------------------------------------------------------------------------|---------------------------------------|
|  | ENO:=RSET(EN,s);<br>ENO:=RSETP(EN,s); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### ■Execution condition

| Instruction | Execution condition                                                                |
|-------------|------------------------------------------------------------------------------------|
| RSET        |   |
| RSETP       |  |

### Setting data

### ■Description, range, data type

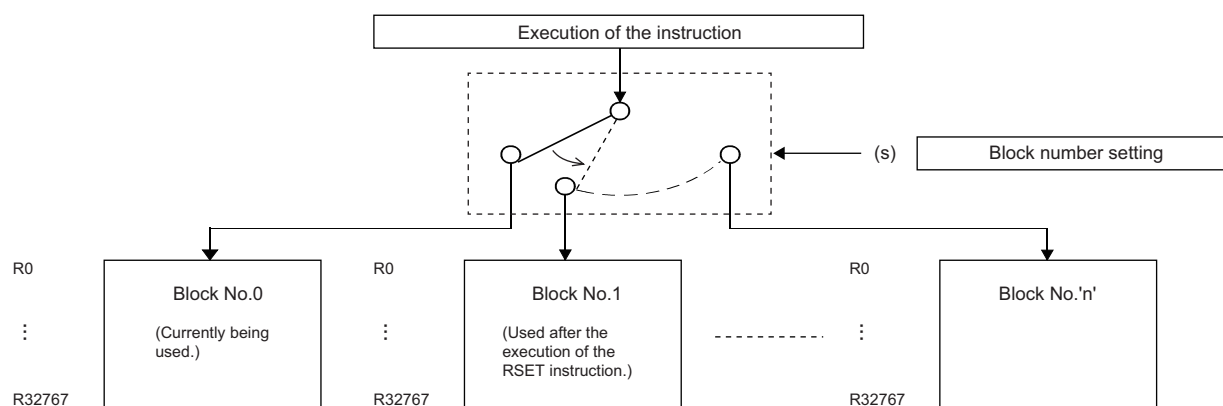
| Operand | Description                                                                                | Range      | Data type            | Data type (label) |
|---------|--------------------------------------------------------------------------------------------|------------|----------------------|-------------------|
| (s)     | Block number data to be changed or the device number where the block number data is stored | 0 to 32767 | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                                        | —          | Bit                  | BOOL              |
| ENO     | Execution result                                                                           | —          | Bit                  | BOOL              |

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

These instructions switch the block number of the file register used in the program to that stored in the device specified by (s). After the block number is changed, all file registers processed by the sequence program are those linked to the new block number.



## Precautions

If "Block No. Save/Recovery Setting" of the file register from the engineering tool is set to "Not Saved/Recovered", do not use this instruction to switch the file register block number in the interrupt program. If the block number is switched, the change may not be reflected immediately after returning from the interrupt program, and the block number may not be switched until the start of the next program.

For the restrictions of the file register, refer to the following.

☞ Page 59 Restrictions on using file registers

## Operation error

| Error code (SD0) | Description                                                     |
|------------------|-----------------------------------------------------------------|
| 2820H            | The specified file register does not exist.                     |
| 3285H            | The block number in the device specified by (s) does not exist. |

# 19.3 File Register Read/Write Instructions

## Reading 1-byte data from the file register

### ZRRDB(P)

These instructions read the data from the file register with the specified serial byte number.

| Ladder | ST                                          |
|--------|---------------------------------------------|
|        | ENO:=ZRRDB(EN,s,d);<br>ENO:=ZRRDBP(EN,s,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ZRRDB       |                     |
| ZRRDBP      |                     |

### Setting data

### Descriptions, ranges, and data types

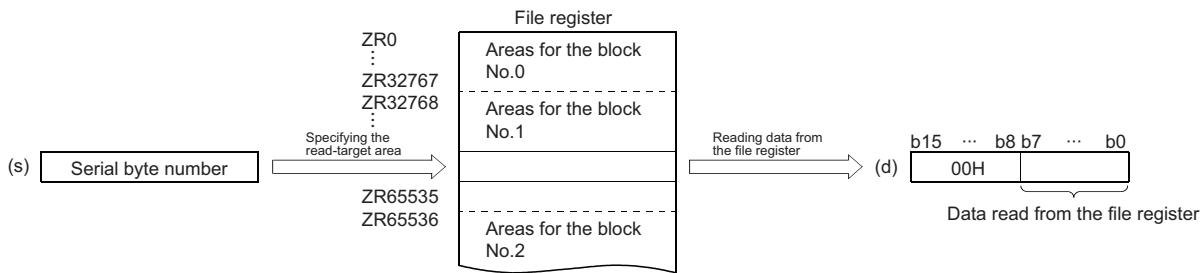
| Operand | Description                                                        | Range           | Data type              | Data type (label) |
|---------|--------------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s)     | Serial byte number of the file register to be read                 | 0 to 4294967295 | 32-bit unsigned binary | ANY32             |
| (d)     | Start number of the device for storing the data that has been read | —               | 16-bit signed binary   | ANY16             |
| EN      | Execution condition                                                | —               | Bit                    | BOOL              |
| ENO     | Execution result                                                   | —               | Bit                    | BOOL              |

### Applicable devices

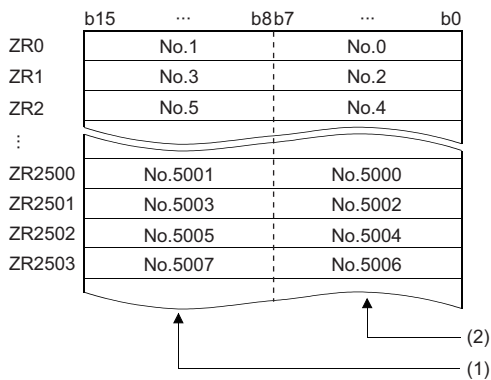
| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | ○   | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- Without recognizing block numbers, these instructions read the data from the file register with the serial byte number specified by (s), and store the data in the lower 8 bits of the device specified by (d). 00H is stored in the upper 8 bits of the device specified by (d).



- The following figure shows the file register numbers corresponding to serial byte numbers.



- (1) Data areas when an odd number is specified  
 (2) Data areas when an even number is specified

### Ex.

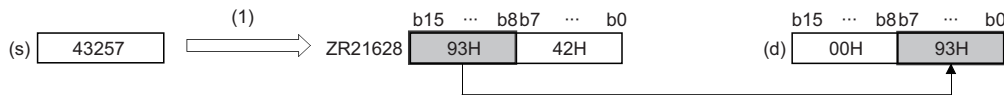
When 23560 is specified in (s), the data in the lower 8 bits of ZR11780 is read.



- (1) Specifying the read-target area

### Ex.

When 43257 is specified in (s), the data in the upper 8 bits of ZR21628 is read.



- (1) Specifying the read-target area

## Operation error

| Error code (SD0) | Description                                                       |
|------------------|-------------------------------------------------------------------|
| 2820H            | The specified device number (serial byte number) is out of range. |

# Writing 1-byte data to the file register

## ZRWRB(P)

These instructions write the data in the lower bits of the specified device to the file register with the specified serial byte number.

| Ladder | ST                                              |
|--------|-------------------------------------------------|
|        | ENO:=ZRWRB(EN,s1,s2);<br>ENO:=ZRWRBP(EN,s1,s2); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ZRWRB       |                     |
| ZRWRBP      |                     |

## Setting data

### Descriptions, ranges, and data types

| Operand | Description                                           | Range           | Data type              | Data type (label) |
|---------|-------------------------------------------------------|-----------------|------------------------|-------------------|
| (s1)    | Serial byte number of the file register to be written | 0 to 4294967295 | 32-bit unsigned binary | ANY32             |
| (s2)    | Device number where the write data is stored          | -32768 to 32767 | 16-bit signed binary   | ANY16             |
| EN      | Execution condition                                   | —               | Bit                    | BOOL              |
| ENO     | Execution result                                      | —               | Bit                    | BOOL              |

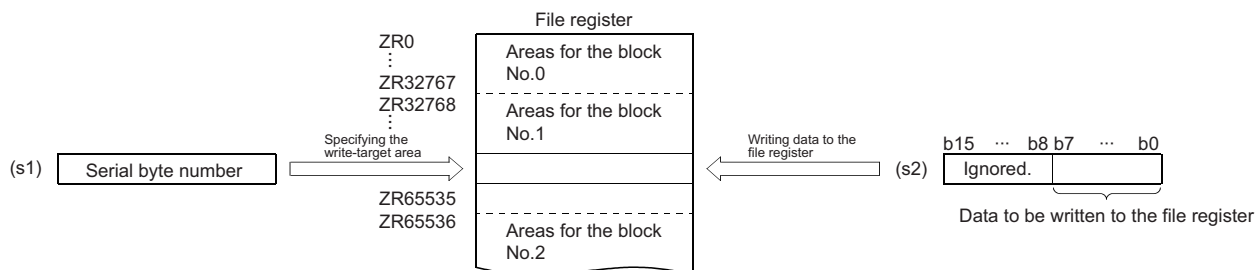
### Applicable devices

| Operand | Bit                              |      | Word                                  |              |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|--------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | ○    | ○                                     | ○            | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○            | ○ | —           | —  | ○                      | ○        | — | —  | —      |

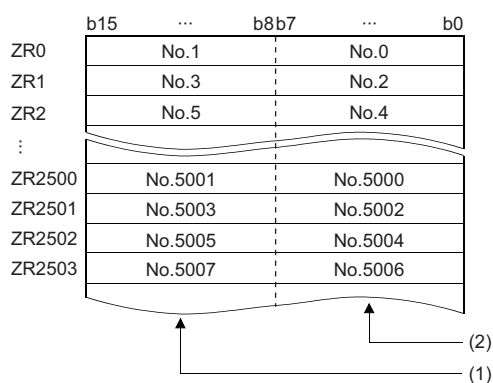


## Processing details

- Without recognizing block numbers, these instructions write the lower 8-bit data stored in the device specified by (s2) to the file register with the serial byte number specified by (s1). The instructions ignore upper 8-bit data in the device specified by (s2).



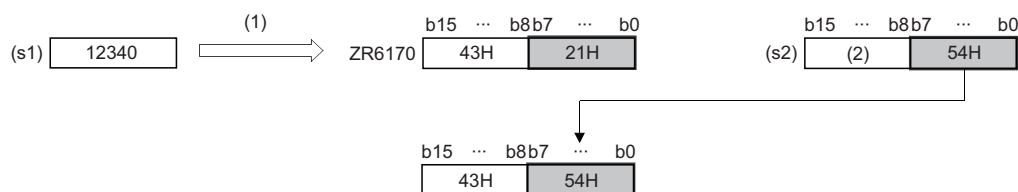
- The following figure shows the file register numbers corresponding to serial byte numbers.



- (1) Data areas when an odd number is specified  
 (2) Data areas when an even number is specified

### Ex.

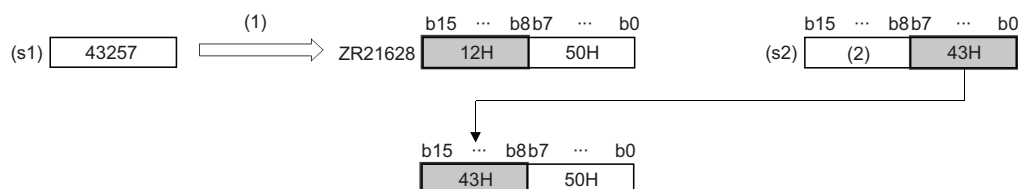
When 12340 is specified in (s1), data is written to the lower 8 bits of ZR11170.



- (1) Specifying the write-target area  
 (2) Ignored

### Ex.

When 43257 is specified in (s1), data is written to the upper 8 bits of ZR21628.



- (1) Specifying the write-target area  
 (2) Ignored

## Operation error

| Error code (SD0) | Description                                                       |
|------------------|-------------------------------------------------------------------|
| 2820H            | The specified device number (serial byte number) is out of range. |

# 19.4 Indirect Address Read Instructions

19

## Reading the indirect address

### ADRSET(P)

These instructions read the indirect address of the specified device.

| Ladder | ST                                                                          |
|--------|-----------------------------------------------------------------------------|
|        | <pre>ENO:=ADRSET(EN,s,d); ENO:=ADRSETP(EN,s,d); ENO:=_ADRSET(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| ADRSET      |                     |
| ADRSETP     |                     |

### Setting data

### Descriptions, ranges, and data types

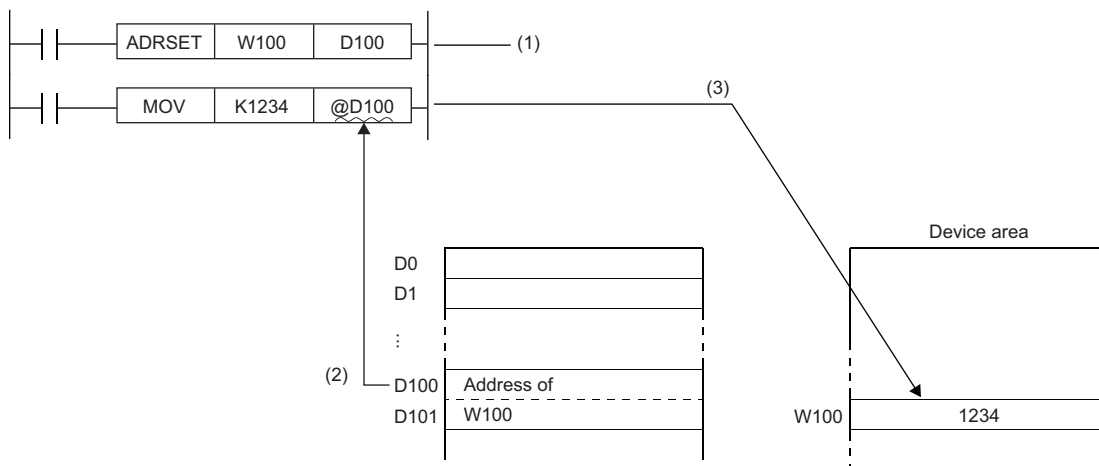
| Operand | Description                                                                                | Range | Data type            | Data type (label) |
|---------|--------------------------------------------------------------------------------------------|-------|----------------------|-------------------|
| (s)     | Number of the device from which the indirect address is to be read                         | —     | Device name          | ANY_ELEMENTARY    |
| (d)     | Start number of the device for storing the indirect address of the device specified by (s) | —     | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                                                        | —     | Bit                  | BOOL              |
| ENO     | Execution result                                                                           | —     | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | —   | ○                                     | —          | — | ○           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions store the indirect address of the device specified by (s), and stores it in the device specified by (d). The address stored in the devices specified by (d)+0 and (d)+1 is used for indirect addressing of the device in the program.



(1) The address of W100 is stored in D100 and D101.

(2) The data (address of W100) stored in D100 and D101 is specified.

(3) "1234" is written to W100.

- Digit specification of bit device or bit specification of word device in (s) is not permitted
- For the indirect specification of devices, refer to the following.

📖 User's manual for the controller used

- Index specification of labels is not supported. When using a label by specifying it in (d), follow the method below.

| Label                                             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Global label specifying a device                  | <p>When using it as an indirect address, use the indirect specification of the device specified in the global label.</p> <p>■Example of ST</p> <pre>ADPSET(TRUE, intVar, gvAddr); // Read the intVar indirect address to gvAddr. INC(TRUE, @D0); // Use the indirect specification of device D0 specified for gvAddr.</pre>                                                                                                                                    |
| Automatic assignment global label/<br>local label | <p>Transfer the indirect address to the device and use the indirect specification of the transfer destination device.</p> <p>■Example of ST</p> <pre>ADPSET(TRUE, intVar, lvAddr); // Read the intVar indirect address to lvAddr. DMOV(TRUE, lvAddr, D0); // Transfer the indirect address, which has been read to lvAddr, to the device. INC(TRUE, @D0); // Use the indirect specification of the device to which the indirect address was transferred.</pre> |

## Operation error

There is no operation error.

# 20 TIMER, COUNTER

20

## 20.1 Special Counter Instructions

### Counting up or down the current value (1-phase input)

#### UDCNT1

This instruction updates the current value of the specified counter.

| Ladder | ST                       |
|--------|--------------------------|
|        | ENO:=UDCNT1(EN,s1,s2,d); |

| FBD/LD |
|--------|
|        |

#### ■Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| UDCNT1      |                     |

#### Setting data

#### ■Descriptions, ranges, and data types

| Operand | Description                                                                                                                                                                       | Range           | Data type            | Data type (label)                                     |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|-------------------------------------------------------|
| (s1)    | (s1)+0: Count input number<br>(s1)+1: Count up/down flag<br>Off indicates count-up (counting up the current value).<br>On indicates count-down (counting down the current value). | —               | Bit                  | ANYBIT_ARRAY* <sup>1</sup><br>(Number of elements: 2) |
| (d)     | Number of the counter (device name) to be counted by the UDCNT1 instruction                                                                                                       | —               | Device name          | ANY16* <sup>2</sup>                                   |
| (s2)    | Set value                                                                                                                                                                         | -32768 to 32767 | 16-bit signed binary | ANY16                                                 |
| EN      | Execution condition                                                                                                                                                               | —               | Bit                  | BOOL                                                  |
| ENO     | Execution result                                                                                                                                                                  | —               | Bit                  | BOOL                                                  |

\*1 Only labels assigned to device (X) can be used.

\*2 Only labels assigned to device (C) can be used.

#### ■Applicable devices

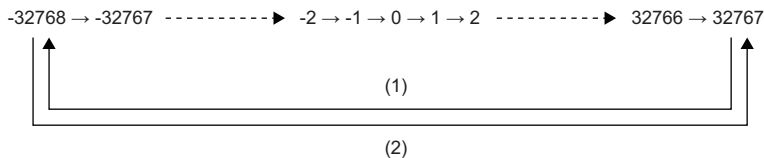
| Operand | Bit                              |      | Word                                  |             |   |             | Double word |   | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|-------------|---|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□□ | Z | LT, LST, LC | LZ          |   |                        | K, H     | E | \$ |        |
| (s1)    | ○* <sup>1</sup>                  | —    | —                                     | —           | — | —           | —           | — | —                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○* <sup>2</sup>                       | —           | — | —           | —           | — | —                      | —        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —           | ○ | ○                      | ○        | — | —  | —      |

\*1 Only X can be used. Note, however, that it can be used only within the range of the number of I/O points (the number of points that can access I/O modules).

\*2 Only C can be used.

## Processing details

- When the input specified by (s1) is turned on, this instruction updates the current value of the counter specified by (d).
- Counting up or down is determined by whether the input specified by (s1)+1 is on or off.
  - Off: Count-up (counting up the current value)
  - On: Count-down (counting down the current value)
- Count processing is performed as follows.
  - When the current value equals the value specified by (s2) during count-up, the contact of the counter specified by (d) is turned on. The current value is kept counting even when the contact of the counter is turned on.
  - When the current value equals "the set value - 1" during countdown, the contact of the counter specified by (d) is turned off.
  - The counter specified by (d) is a ring counter. Counting up the counter when the current value is 32767 proceeds to -32768. Similarly, counting down the counter when the current value is -32768 proceeds to 32767. The following figure shows the processing for counting the current value.

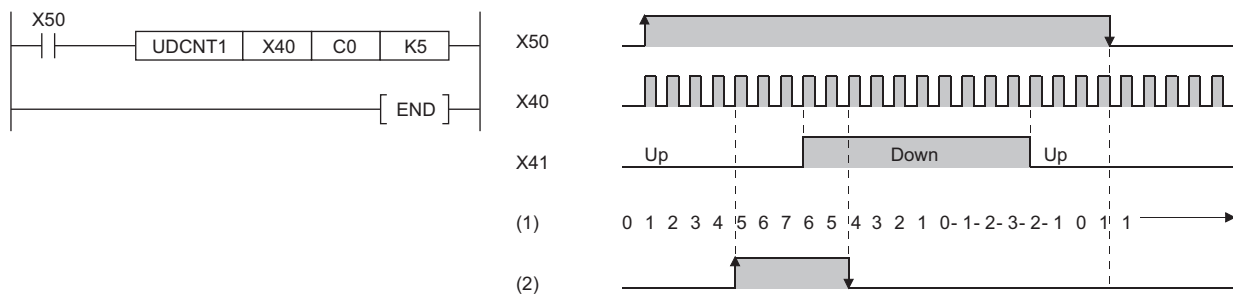


- (1) When counting up  
(2) When counting down

- The following figure shows the operation of count processing using the UDCNT1 instruction.

**Ex.**

Program which uses C0 (up/down counter) to count the number of times X40 turns off and on after X50 turns on



- (1) Current value of C0  
(2) Contact of C0

- When executed, the UDCNT1 instruction starts counting when the execution command turns on and stops counting when the command turns off. If the execution command is turned on again, the instruction resumes counting from the current value with which it stopped counting previously.
- The RST instruction is used to clear the current value of the counter specified by (d) and turn off the contact.

## Point

- The UDCNT1 instruction stores the device data of the argument in the work area of the controller, and performs the actual count operation using system interrupts. (The device data stored in the work area of the controller is cleared by turning off the execution command or setting it to STOP then RUN.) For this reason, the pulses that can be counted must have longer on/off time than the interval of the controller. The interrupt interval of the controller is 1ms.
- The set value cannot be changed during counting by the UDCNT1 instruction (while the execution command is on). To change the set value, turn off the execution command in advance.
- The counter specified by the UDCNT1 instruction cannot be used by any other instruction. If another instruction uses it, normal counting is disabled.
- The UDCNT1 instruction can be used a maximum of six times in all running programs. The seventh or subsequent UDCNT1 instruction, if issued, causes no processing.

## Operation error

There is no operation error.

# Counting up or down the current value (2-phase input)

20

## UDCNT2

This instruction updates the current value of the counter depending on the status of phases A and B pulses.

| Ladder | ST                       |
|--------|--------------------------|
|        | ENO:=UDCNT2(EN,s1,s2,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| UDCNT2      |                     |

### Setting data

### Descriptions, ranges, and data types

| Operand | Description                                                                              | Range           | Data type            | Data type (label)                                     |
|---------|------------------------------------------------------------------------------------------|-----------------|----------------------|-------------------------------------------------------|
| (s1)    | (s1)+0: Count input number (phase A pulse)<br>(s1)+1: Count input number (phase B pulse) | —               | Bit                  | ANYBIT_ARRAY* <sup>1</sup><br>(Number of elements: 2) |
| (d)     | Number of the counter (device name) to be counted by the UDCNT2 instruction              | —               | Device name          | ANY16* <sup>2</sup>                                   |
| (s2)    | Set value                                                                                | -32768 to 32767 | 16-bit signed binary | ANY16                                                 |
| EN      | Execution condition                                                                      | —               | Bit                  | BOOL                                                  |
| ENO     | Execution result                                                                         | —               | Bit                  | BOOL                                                  |

\*1 Only labels assigned to device (X) can be used.

\*2 Only labels assigned to device (C) can be used.

### Applicable devices

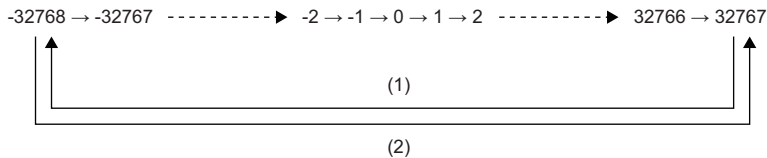
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○* <sup>1</sup>                  | —    | —                                     | —           | — | —           | —  | —                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○* <sup>2</sup>                       | —           | — | —           | —  | —                      | —        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

\*1 Only X can be used. Note, however, that it can be used only within the range of the number of I/O points (the number of points that can access I/O modules).

\*2 Only C can be used.

## Processing details

- This instruction updates the current value of the counter specified by (d) depending on the status of the input (phase A pulse) specified by (s1) and the status of the input (phase B pulse) specified by (s1)+1.
- Counting up or down is determined as follows.
  - (s1)+1 is turned on while (s1) is on: Count-up (counting up the current value)
  - (s1)+1 is turned off while (s1) is on: Countdown (counting down the current value)
  - The instruction does not count while (s1) is off.
- Count processing is performed as follows.
  - When the current value equals the value specified by (s2) during count-up, the contact of the counter specified by (d) is turned on. The current value is kept counting even when the contact of the counter is turned on.
  - When the current value equals "the set value - 1" during countdown, the contact of the counter specified by (d) is turned off.
  - The counter specified by (d) is a ring counter. Counting up the counter when the current value is 32767 proceeds to -32768. Similarly, counting down the counter when the current value is -32768 proceeds to 32767. The following figure shows the processing for counting the current value.

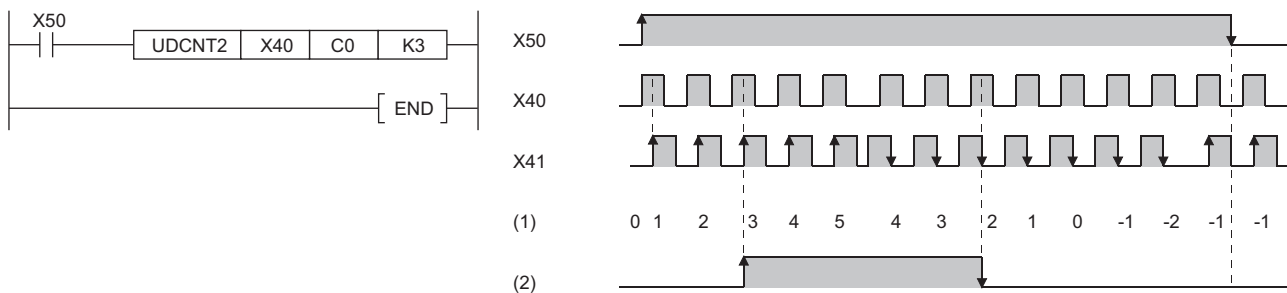


- (1) When counting up  
(2) When counting down

- The following figure shows the operation of count processing using the UDCNT2 instruction.

### Ex.

Program which uses C0 (up/down counter) to count the states of X40 and X41 after X50 turns on



- (1) Current value of C0  
(2) Contact of C0
- When executed, the UDCNT2 instruction starts counting when the execution command turns on and stops counting when the command turns off. If the execution command is turned on again, the instruction resumes counting from the current value with which it stopped counting previously.
  - The RST instruction is used to clear the current value of the counter specified by (d) and turn off the contact.

## Point

- The UDCNT2 instruction stores the device data of the argument in the work area of the controller, and performs the actual count operation using system interrupts. (The device data stored in the work area of the controller is cleared by turning off the execution command or setting it to STOP then RUN.) For this reason, the pulses that can be counted must have longer on/off time than the interval of the controller. The interrupt interval of the controller is 1ms.
- The set value cannot be changed during counting by the UDCNT2 instruction (while the execution command is on). To change the set value, turn off the execution command in advance.
- The counter specified by the UDCNT2 instruction cannot be used by any other instruction. If another instruction uses it, normal counting is disabled.
- The UDCNT2 instruction can be used a maximum of five times in all running programs. The sixth or subsequent UDCNT1 instruction, if issued, causes no processing.

## Operation error

There is no operation error.



## 20.2 Special Timer Instructions

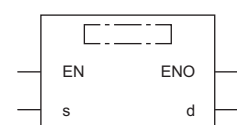
20

### Teaching timer

#### TTMR

This instruction measures the on time of the measurement command in seconds, multiplies it by a multiplier, and stores the operation result.

| Ladder | ST                 |
|--------|--------------------|
|        | ENO:=TTMR(EN,s,d); |
| FBD/LD |                    |



#### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| TTMR        |                     |

#### Setting data

#### Descriptions, ranges, and data types

| Operand | Description                                     | Range  | Data type            | Data type (label)                      |
|---------|-------------------------------------------------|--------|----------------------|----------------------------------------|
| (d)     | (d)+0: Device for storing the measurement value | —      | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 2) |
|         | (d)+1: For controller system                    |        |                      |                                        |
| (s)     | Multiplier of measurement value                 | 0 to 2 | 16-bit signed binary | ANY16                                  |
| EN      | Execution condition                             | —      | Bit                  | BOOL                                   |
| ENO     | Execution result                                | —      | Bit                  | BOOL                                   |

#### Applicable devices

| Operand | Bit                              |      | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | —                                | —    | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (s)     | —                                | ○    | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

#### Control data

| Operand: (d) |                                          |               |        |
|--------------|------------------------------------------|---------------|--------|
| Device       | Description                              | Setting range | Set by |
| +0           | Device for storing the measurement value | —             | System |
| +1           | For controller system                    | —             | System |

## Processing details

- This instruction measures the on time of the execution command in seconds, multiplies it by the multiplier specified by (s), and stores the resultant value in the device specified by (d).
- When the execution command is turned on, the instruction clears the device specified by (d)+0, (d)+1.
- The table below lists the multipliers that can be specified by (s).

| (s) | Multiplier |
|-----|------------|
| 0   | 1          |
| 1   | 10         |
| 2   | 100        |

- When the value in the device specified by (s) is not in the range from 0 to 2, no processing is performed.

### Point

- When executed, the TTMR instruction implements time measurement. Do not use the JMP instruction to skip the TTMR instruction. Otherwise, accurate measurement is disabled.
- Do not change the multiplier specified by (s) during execution of the TTMR instruction. Otherwise, accurate values cannot be determined.
- The device specified by (d)+1 is used by the system of the controller. Do not change the value. If the value is changed, an accurate resultant value is not stored in the device specified by (d).

## Operation error

There is no operation error.

# Special function timer

20

## STMR

This instruction implements the following four types of timer output.

- Off delay timer output
- After-off one-shot timer output
- After-on one-shot timer output
- On delay + off delay timer output

| Ladder | ST                     |
|--------|------------------------|
|        | ENO:=STMR(EN,s1,s2,d); |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| STMR        | Every scan          |

## Setting data

## Description, range, data type

| Operand | Description                                                                                                                                                  | Range      | Data type            | Data type (label)                       |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------|-----------------------------------------|
| (s1)    | Timer device or timer type label                                                                                                                             | —          | Device name          | ANY16                                   |
| (s2)    | Set value                                                                                                                                                    | 0 to 32767 | 16-bit signed binary | ANY16                                   |
| (d)     | (d)+0: Off delay timer output<br>(d)+1: After-off one-shot timer output<br>(d)+2: After-on one-shot timer output<br>(d)+3: On delay + off delay timer output | —          | Bit                  | ANYBIT_ARRAY<br>(Number of elements: 4) |
| EN      | Execution condition                                                                                                                                          | —          | Bit                  | BOOL                                    |
| ENO     | Execution result                                                                                                                                             | —          | Bit                  | BOOL                                    |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○*1                                   | —           | — | —           | —  | —                      | —        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | —    | —                                     | —           | — | —           | —  | —                      | —        | — | —  | —      |

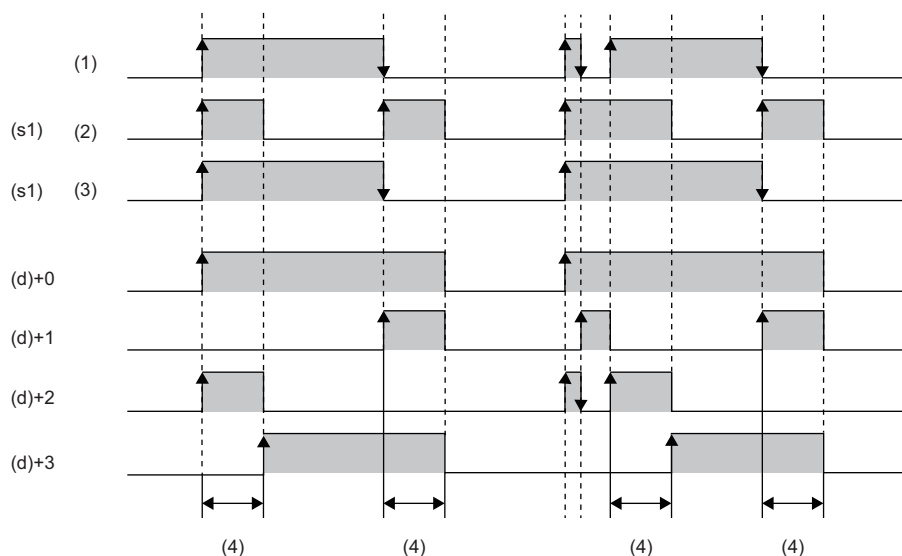
\*1 Only T can be used.

## Processing details

- This instruction uses four points from the device specified by (d) to implement four types of timer output.

| Setting data | Description |                                   |                                                                                                                                                                                  |
|--------------|-------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (d)          | +0          | Off delay timer output:           | Turns on on the rising edge of the command of the STMR instruction, and turns off after a lapse of the time specified by (s2) after the falling edge of the command.             |
|              | +1          | After-off one-shot timer output   | Turns on on the falling edge of the command of the STMR instruction, and turns off after a lapse of the time specified by (s2).                                                  |
|              | +2          | After-on one-shot timer output    | Turns on on the falling edge of the command of the STMR instruction, and turns off after a lapse of the time specified by (s2) or when the command of the instruction turns off. |
|              | +3          | On delay + off delay timer output | Turns on on the falling edge of the timer coil, and turns off after a lapse of the time specified by (s2) after the falling edge of the command of the STMR instruction.         |

- The coil of the timer specified by (s1) turns on, on the rising and falling edges of the command of the STMR instruction, to start measurement of the current value.
- The coil of the timer keeps measurement during the time specified by (s2) and turns off when the time is up.
- The coil of the timer is kept on even if the STMR instruction is turned off before time-up. Timer measurement is continued. When the STMR instruction is turned on again, the coil resets the current value to 0 and restarts measurement.
- The contact of the timer turns on, on the rising edge of the command of the STMR instruction, and turns off on the falling edge of the command after the coil of the timer falls. Users cannot use the contact of the timer because it is reserved for the system.



- (1) Command for the STMR instruction  
 (2) Coil  
 (3) Contact  
 (4) Value specified by (s2)

- Measurement of the current value of the timer specified by the STMR instruction is executed regardless of whether the command of the STMR instruction is on or off. If the STMR instruction is skipped such as by the JMP instruction, normal measurement is not performed.
- The measurement unit of the timer specified by (d) is the same as that of the low-speed timer.
- A value from 0 to 32767 can be specified in (s2). If a value out of the range is specified, no processing is performed.
- Do not use the OUT instruction for the timer specified by (s1). If the same timer device or timer type label is used for the STMR and OUT instructions, normal operation is not performed.

## Precautions

If there is an STMR instruction within the range for changing the ladder block online or writing data to the running programmable controller, the STMR instruction is executed.

For details, refer to the following.

📖 User's manual for the controller used

## Operation error

There is no operation error.

# 21 CLOCK

## 21.1 Clock Instructions

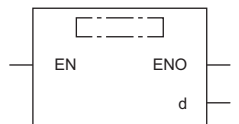
### Reading clock data

#### DATERD(P)

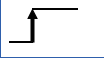
Reads "year, month, day, hour, minute, second, and day of week" from the clock element of the controller.

| Ladder                                                                            | ST                                        |
|-----------------------------------------------------------------------------------|-------------------------------------------|
|  | ENO:=DATERD(EN,d);<br>ENO:=DATERDP(EN,d); |

#### FBD/LD



#### ■Execution condition

| Instruction | Execution condition                                                                 |
|-------------|-------------------------------------------------------------------------------------|
| DATERD      |  |
| DATERDP     |  |

### Setting data

#### ■Description, range, data type

| Operand | Description                                                | Range | Data type            | Data type (label)                      |
|---------|------------------------------------------------------------|-------|----------------------|----------------------------------------|
| (d)     | Start device for storing the clock data that has been read | —     | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 7) |
| EN      | Execution condition                                        | —     | Bit                  | BOOL                                   |
| ENO     | Execution result                                           | —     | Bit                  | BOOL                                   |

#### ■Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (d)     | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions read "year, month, day, hour, minute, second, and day of week" from the clock element of the controller, and store the read data in binary in the device specified by (d) and later.

| (Data)          | (d)          | (d)+1   | (d)+2   | (d)+3   | (d)+4   | (d)+5   | (d)+6       |
|-----------------|--------------|---------|---------|---------|---------|---------|-------------|
| (Clock element) | Year         | Month   | Day     | Hour    | Minute  | Second  | Day of week |
| (Setting range) | 1980 to 2079 | 1 to 12 | 1 to 31 | 0 to 23 | 0 to 59 | 0 to 59 | 0 to 6      |

- "Year" stored in the device specified by (d) is a 4-digit year.
- "Day of week" stored in the device specified by (d)+6 is a number from 0 to 6 corresponding to Sunday to Saturday.

| Day of week | Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|-------------|--------|--------|---------|-----------|----------|--------|----------|
| Stored data | 0      | 1      | 2       | 3         | 4        | 5      | 6        |

- Data is automatically corrected in leap years.

## Operation error

There is no operation error.

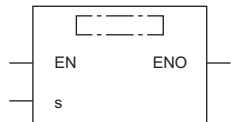
# Writing clock data

## DATEWR(P)

Writes the clock data stored in the specified device and later to the clock element of the controller.

| Ladder | ST                                        |
|--------|-------------------------------------------|
|        | ENO:=DATEWR(EN,s);<br>ENO:=DATEWRP(EN,s); |

## FBD/LD



### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DATEWR      |                     |
| DATEWRP     |                     |

## Setting data

### Description, range, data type

| Operand | Description                                                                    | Range                          | Data type            | Data type (label)                      |
|---------|--------------------------------------------------------------------------------|--------------------------------|----------------------|----------------------------------------|
| (s)     | Start device where the clock data to be written to the clock element is stored | Refer to "Processing details". | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 7) |
| EN      | Execution condition                                                            | —                              | Bit                  | BOOL                                   |
| ENO     | Execution result                                                               | —                              | Bit                  | BOOL                                   |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |



## Processing details

- These instructions write the clock data stored in the specified device and later to the clock element of the controller.

| (Data)          | (d)          | (d)+1   | (d)+2   | (d)+3   | (d)+4   | (d)+5   | (d)+6       |
|-----------------|--------------|---------|---------|---------|---------|---------|-------------|
| (Clock element) | Year         | Month   | Day     | Hour    | Minute  | Second  | Day of week |
| (Setting range) | 1980 to 2079 | 1 to 12 | 1 to 31 | 0 to 23 | 0 to 59 | 0 to 59 | 0 to 6      |

- Set each data in binary.
- Set the year data in the range from 1980 to 2079 in the device specified by (s).
- Set the month data in the range from 1 to 12 in the device specified by (s)+1.
- Set the day data in the range from 1 to 31 in the device specified by (s)+2.
- Set the hour data in the range from 0 to 23 in the device specified by (s)+3. (Set in 24-hour format.)
- Set the minute data in the range from 0 to 59 in the device specified by (s)+4.
- Set the second data in the range from 0 to 59 in the device specified by (s)+5.
- Set the day of week in the range from 0 to 6 corresponding to Sunday to Saturday in the device specified by (s)+6.

| Day of week | Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|-------------|--------|--------|---------|-----------|----------|--------|----------|
| Stored data | 0      | 1      | 2       | 3         | 4        | 5      | 6        |

## Operation error

| Error code (SD0) | Description                                                                                            |
|------------------|--------------------------------------------------------------------------------------------------------|
| 3285H            | Out-of-range data is set in (s) to (s)+6.                                                              |
| 3295H            | A time value less than an hour from the start time of the daylight-saving time is set in (s) to (s)+6. |

### Point

When clock data is changed, "clock setting" (event code: 24000) is saved to the event history. Therefore, "clock setting" is saved to the event history when this instruction is executed.

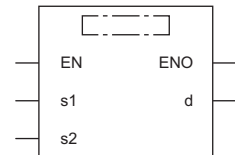
# Adding clock data

## DATE+(P)

These instructions add time data.

| Ladder | ST                                                                |
|--------|-------------------------------------------------------------------|
|        | <pre>ENO:=DATEPLUS(EN,s1,s2,d); ENO:=DATEPLUSP(EN,s1,s2,d);</pre> |

## FBD/LD



(□ is replaced by either of the following: DATEPLUS, DATEPLUSP.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DATE+       |                     |
| DATE+P      |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                    | Range                          | Data type            | Data type (label)                      |
|---------|----------------------------------------------------------------|--------------------------------|----------------------|----------------------------------------|
| (s1)    | Start device where the augend clock data is stored             | Refer to "Processing details". | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 3) |
| (s2)    | Start device where the addend time (clock) data is stored      | Refer to "Processing details". | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 3) |
| (d)     | Start device for storing the addition result time (clock) data | —                              | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 3) |
| EN      | Execution condition                                            | —                              | Bit                  | BOOL                                   |
| ENO     | Execution result                                               | —                              | Bit                  | BOOL                                   |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions add the time data in the device specified by (s2) to the time data in the device specified by (s1), and store the addition result in the device number specified by (d) and later.

|        |        |           |   |        |        |           |   |       |        |           |
|--------|--------|-----------|---|--------|--------|-----------|---|-------|--------|-----------|
| (s1)   | hour   | (0 to 23) |   | (s2)   | hour   | (0 to 23) |   | (d)   | hour   | (0 to 23) |
| (s1)+1 | minute | (0 to 59) | + | (s2)+1 | minute | (0 to 59) | ⇒ | (d)+1 | minute | (0 to 59) |
| (s1)+2 | second | (0 to 59) |   | (s2)+2 | second | (0 to 59) |   | (d)+2 | second | (0 to 59) |

### Ex.

7:48:10 is added to 6:32:40.

|        |    |   |        |    |   |       |    |
|--------|----|---|--------|----|---|-------|----|
| (s1)   | 6  |   | (s2)   | 7  |   | (d)   | 14 |
| (s1)+1 | 32 | + | (s2)+1 | 48 | ⇒ | (d)+1 | 20 |
| (s1)+2 | 40 |   | (s2)+2 | 10 |   | (d)+2 | 50 |

- If the time obtained as the result of addition exceeds 24 hours, 24 hours are subtracted from the resultant time to produce the operation result. For example, when 20:20:20 is added to 14:20:30, the operation result is 10:40:50 rather than 34:40:50.

|        |    |   |        |    |   |       |    |
|--------|----|---|--------|----|---|-------|----|
| (s1)   | 14 |   | (s2)   | 20 |   | (d)   | 10 |
| (s1)+1 | 20 | + | (s2)+1 | 20 | ⇒ | (d)+1 | 40 |
| (s1)+2 | 30 |   | (s2)+2 | 20 |   | (d)+2 | 50 |

## Operation error

| Error code (SD0) | Description                                                       |
|------------------|-------------------------------------------------------------------|
| 3285H            | The data in the device specified by (s1) or (s2) is out of range. |

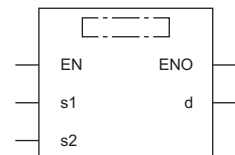
# Subtracting clock data

## DATE-(P)

These instructions subtract time data.

| Ladder | ST                                                                  |
|--------|---------------------------------------------------------------------|
|        | <pre>ENO:=DATEMINUS(EN,s1,s2,d); ENO:=DATEMINUSP(EN,s1,s2,d);</pre> |

## FBD/LD



(□ is replaced by either of the following: DATEMINUS, DATEMINUSP.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DATE-       |                     |
| DATE-P      |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                       | Range                          | Data type            | Data type (label)                      |
|---------|-------------------------------------------------------------------|--------------------------------|----------------------|----------------------------------------|
| (s1)    | Start device where minuend clock data is stored                   | Refer to "Processing details". | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 3) |
| (s2)    | Start device where the subtrahend time (clock) data is stored     | Refer to "Processing details". | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 3) |
| (d)     | Start device for storing the subtraction result time (clock) data | —                              | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 3) |
| EN      | Execution condition                                               | —                              | Bit                  | BOOL                                   |
| ENO     | Execution result                                                  | —                              | Bit                  | BOOL                                   |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions subtract the time data in the device specified by (s2) from the time data in the device specified by (s1), and store the subtraction result in the device number specified by (d) and later.

|        |        |           |   |        |        |           |   |       |        |           |
|--------|--------|-----------|---|--------|--------|-----------|---|-------|--------|-----------|
| (s1)   | hour   | (0 to 23) |   | (s2)   | hour   | (0 to 23) |   | (d)   | hour   | (0 to 23) |
| (s1)+1 | minute | (0 to 59) | - | (s2)+1 | minute | (0 to 59) | ⇒ | (d)+1 | minute | (0 to 59) |
| (s1)+2 | second | (0 to 59) |   | (s2)+2 | second | (0 to 59) |   | (d)+2 | second | (0 to 59) |

### Ex.

3:50:10 is subtracted from 10:40:20.

|        |    |   |        |    |   |       |    |
|--------|----|---|--------|----|---|-------|----|
| (s1)   | 10 |   | (s2)   | 3  |   | (d)   | 6  |
| (s1)+1 | 40 | - | (s2)+1 | 50 | ⇒ | (d)+1 | 50 |
| (s1)+2 | 20 |   | (s2)+2 | 10 |   | (d)+2 | 10 |

- If the time obtained as the result of subtraction becomes a negative value, 24 hours are added to the resultant time to produce the operation result. For example, when 10:42:12 is subtracted from 4:50:32, the operation result is 18:8:20 rather than -6:8:20.

|        |    |   |        |    |   |       |    |
|--------|----|---|--------|----|---|-------|----|
| (s1)   | 4  |   | (s2)   | 10 |   | (d)   | 18 |
| (s1)+1 | 50 | - | (s2)+1 | 42 | ⇒ | (d)+1 | 8  |
| (s1)+2 | 32 |   | (s2)+2 | 12 |   | (d)+2 | 20 |

## Operation error

| Error code (SD0) | Description                                                       |
|------------------|-------------------------------------------------------------------|
| 3285H            | The data in the device specified by (s1) or (s2) is out of range. |

# Converting time data from hour/minute/second to second

## TIME2SEC(P)

These instructions convert time data (hour, minute, second) to second data.

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=TIME2SEC(EN,s,d); ENO:=TIME2SECP(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| TIME2SEC    |                     |
| TIME2SECP   |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                | Range | Data type            | Data type (label)                      |
|---------|------------------------------------------------------------|-------|----------------------|----------------------------------------|
| (s)     | Start device where the time data to be converted is stored | —     | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 3) |
| (d)     | Start device for storing the clock data after conversion   | —     | 32-bit signed binary | ANY32                                  |
| EN      | Execution condition                                        | —     | Bit                  | BOOL                                   |
| ENO     | Execution result                                           | —     | Bit                  | BOOL                                   |

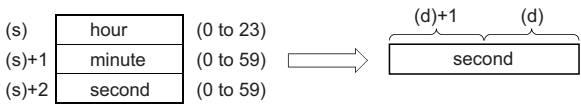
### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○*1                              | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

\*1 FX and FY cannot be used.

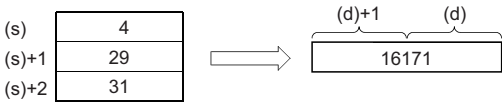
### Processing details

These instructions convert the time data stored in the device number specified by (s) and later to second data, and store the operation result in the device specified by (d).



**Ex.**

4:29:31 is specified in (s).



### Operation error

| Error code (SD0) | Description                                           |
|------------------|-------------------------------------------------------|
| 3285H            | The data in the device specified (s) is out of range. |

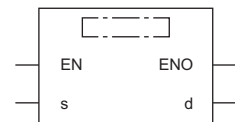
# Converting time data from second to hour/minute/second

## SEC2TIME(P)

These instructions convert second data to time data (hour, minute, second).

| Ladder | ST                                                        |
|--------|-----------------------------------------------------------|
|        | <pre>ENO:=SEC2TIME(EN,s,d); ENO:=SEC2TIMEP(EN,s,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| SEC2TIME    |                     |
| SEC2TIMEP   |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                | Range      | Data type            | Data type (label)                      |
|---------|------------------------------------------------------------|------------|----------------------|----------------------------------------|
| (s)     | Start device where the time data to be converted is stored | 0 to 86399 | 32-bit signed binary | ANY32                                  |
| (d)     | Start device for storing the clock data after conversion   | —          | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 3) |
| EN      | Execution condition                                        | —          | Bit                  | BOOL                                   |
| ENO     | Execution result                                           | —          | Bit                  | BOOL                                   |

## Applicable devices

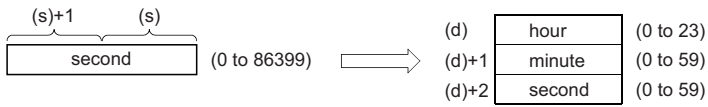
| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○*1                              | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

\*1 FX and FY cannot be used.



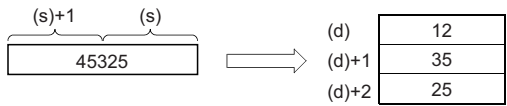
### Processing details

These instructions convert the seconds data stored in the device number specified by (s) and later to time data (hour, minute, second), and store the operation result in the device specified by (d) and later.



**Ex.**

45325 seconds are specified in (s).



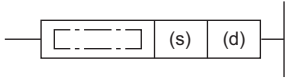
### Operation error

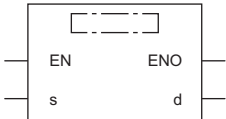
| Error code (SD0) | Description                                           |
|------------------|-------------------------------------------------------|
| 3285H            | The data in the device specified (s) is out of range. |

# Converting date and time data from date and time to second

## DATE2SEC(P)(\_U)

These instructions convert date and time data into second.

| Ladder                                                                            | ST                                                                                                         |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
|  | ENO:=DATE2SEC(EN,s,d);<br>ENO:=DATE2SECP(EN,s,d);<br>ENO:=DATE2SEC_U(EN,s,d);<br>ENO:=DATE2SECP_U(EN,s,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction              | Execution condition                                                               |
|--------------------------|-----------------------------------------------------------------------------------|
| DATE2SEC<br>DATE2SEC_U   |  |
| DATE2SECP<br>DATE2SECP_U |  |

### Setting data

### Description, range, data type

| Operand                      | Description                                                         | Range                          | Data type              | Data type (label)                      |
|------------------------------|---------------------------------------------------------------------|--------------------------------|------------------------|----------------------------------------|
| (s)                          | Start device where the date and time data to be converted is stored | Refer to the function details. | 16-bit signed binary   | ANY16_ARRAY<br>(Number of elements: 6) |
| (d)                          | Start device for storing the converted second data                  | 0 to 2145916799                | 32-bit signed binary   | ANY32                                  |
| DATE2SEC(P)<br>DATE2SEC(P)_U |                                                                     | 0 to 3155759999                | 32-bit unsigned binary | ANY32_U                                |
| EN                           | Execution condition                                                 | —                              | Bit                    | BOOL                                   |
| ENO                          | Execution result                                                    | —                              | Bit                    | BOOL                                   |

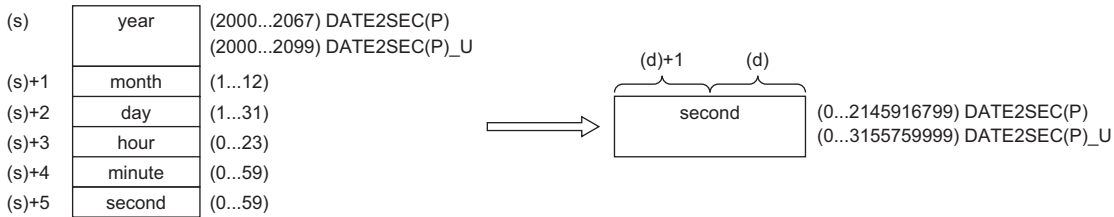
### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○*1                              | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | —        | — | —  | —      |

\*1 FX and FY cannot be used.

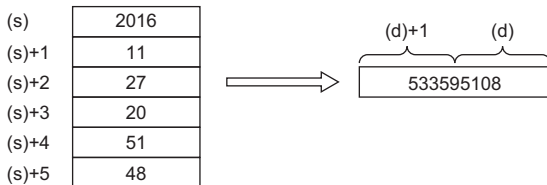
## Processing details

- These instructions convert the date and time data stored in the device number specified by (s) and later into second data, and store the operation result in the device specified by (d). The starting point (0 second) is January 1, 2000 at 00:00:00.



- The year data range is 2000 to 2067 for DATE2SEC(P) and 2000 to 2099 for DATE2SEC(P)\_U.

For example, the following shows when November 27, 2016 at 20:51:48 is specified.



- Changing clock data (including the time zone and time adjustment by daylight-saving time) does not affect the operation of these instructions. For example, the operation result during the season when the daylight-saving time is applied is same as the result during the season when the daylight-saving time is not applied.

## Operation error

| Error code (SD0) | Description                                                             |
|------------------|-------------------------------------------------------------------------|
| 3285H            | The data in the device specified (s) is out of range.                   |
|                  | A non-existent date and time is specified. (Example: February 30, 2016) |

# Converting date and time data from second to date and time

## SEC2DATE(P)(\_U)

These instructions convert second data into date and time data.

| Ladder | ST                                                                                                           |
|--------|--------------------------------------------------------------------------------------------------------------|
|        | <pre>ENO:=SEC2DATE(EN,s,d); ENO:=SEC2DATEP(EN,s,d); ENO:=SEC2DATE_U(EN,s,d); ENO:=SEC2DATEP_U(EN,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction              | Execution condition |
|--------------------------|---------------------|
| SEC2DATE<br>SEC2DATE_U   |                     |
| SEC2DATEP<br>SEC2DATEP_U |                     |

### Setting data

### Description, range, data type

| Operand       | Description                                                  | Range                          | Data type              | Data type (label)                      |
|---------------|--------------------------------------------------------------|--------------------------------|------------------------|----------------------------------------|
| (s)           | Start device where the second data to be converted is stored | 0 to 2145916799                | 32-bit signed binary   | ANY32                                  |
| SEC2DATE(P)_U |                                                              | 0 to 3155759999                | 32-bit unsigned binary | ANY32_U                                |
| (d)           | Start device for storing the converted date and time data    | Refer to the function details. | 16-bit signed binary   | ANY16_ARRAY<br>(Number of elements: 7) |
| EN            | Execution condition                                          | —                              | Bit                    | BOOL                                   |
| ENO           | Execution result                                             | —                              | Bit                    | BOOL                                   |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○*1                              | ○    | ○                                     | ○           | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

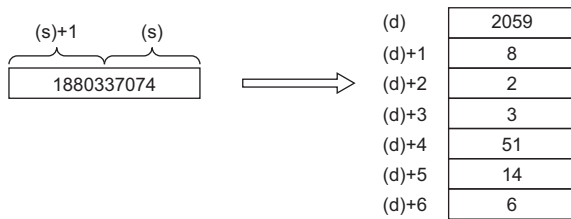
\*1 FX and FY cannot be used.

## Processing details

- These instructions convert the second data stored in the device number specified by (s) and later into date and time data, and store the operation result in the device specified by (d) and later. The starting point (0 second) is January 1, 2000 at 00:00:00.



For example, the following shows 1880337074 seconds are specified.



- Day of week stored in the device specified by (d)+6 is a number from "0 to 6" corresponding to "Sunday to Saturday".

| Day of week | Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|-------------|--------|--------|---------|-----------|----------|--------|----------|
| Stored data | 0      | 1      | 2       | 3         | 4        | 5      | 6        |

- Changing clock data (including the time zone and time adjustment by daylight-saving time) does not affect the operation of these instructions. For example, the operation result during the season when the daylight-saving time is applied is same as the result during the season when the daylight-saving time is not applied.

## Operation error

| Error code (SD0) | Description                                           |
|------------------|-------------------------------------------------------|
| 3285H            | The data in the device specified (s) is out of range. |

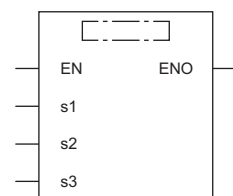
# Comparing date data

## LDDT□, ANDDT□, ORDT□

These instructions compare the specified date data, or compare the date data with the current date.

| Ladder                                                                     | ST                                                                                                                                                             |
|----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(□ indicates DT=, DT&lt;&gt;, DT&gt;, DT&lt;=, DT&lt;, or DT&gt;=.)</p> | <pre> ENO:=LDDT_□(EN,s1,s2,s3); ENO:=ANDDT_□(EN,s1,s2,s3); ENO:=ORDT_□(EN,s1,s2,s3); (□ is replaced by any of the following: EQ, NE, GT, LE, LT, GE.)*1 </pre> |

## FBD/LD



(□ is replaced by a combination of LDDT\_, ANDDT\_, or ORDT\_ and EQ, NE, GT, LE, LT, or GE.)\*1

\*1 EQ indicates =, NE indicates <>, GT indicates >, LE indicates <=, LT indicates <, and GE indicates >=.

## Execution condition

| Instruction          | Execution condition |
|----------------------|---------------------|
| LDDT□, ANDDT□, ORDT□ | Every scan          |

## Setting data

## Description, range, data type

| Operand | Description                                                             | Range                          | Data type            | Data type (label) |
|---------|-------------------------------------------------------------------------|--------------------------------|----------------------|-------------------|
| (s1)    | Start device where the data to be compared is stored                    | —                              | 16-bit signed binary | ANY_DT*1          |
| (s2)    | Start device where the data to be compared is stored                    | —                              | 16-bit signed binary | ANY_DT*1          |
| (s3)    | Comparison target setting value or the number of comparison target data | 0001H to 0007H, 8001H to 8007H | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                                     | —                              | Bit                  | BOOL              |
| ENO     | Execution result                                                        | —                              | Bit                  | BOOL              |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

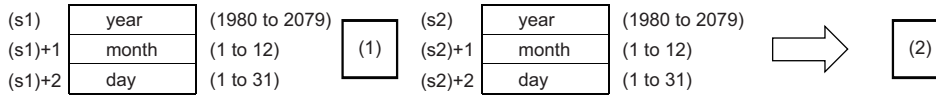
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (s3)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions compare the date data in the devices specified by (s1) and (s2), or compare the date data in the device specified by (s1) with the current date. Set the comparison target by (s3).

- Comparing two specified date data

These instructions compare the date data in the device specified by (s1) with the date data in the device specified by (s2) in accordance with the conditions set by (s3). (Devices are used as a normally open contact.)

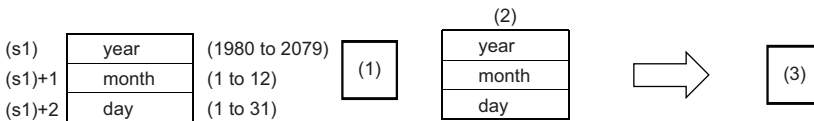


(1)Relational operator

(2)Comparison result

- Comparing the specified date data with the current date

These instructions compare the date data in the device specified by (s1) with the current date data in accordance with the conditions set by (s3). (Devices are used as a normally open contact.) The date data in the device specified by (s2) is regarded as dummy data and ignored.

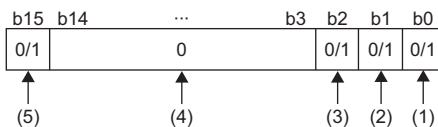


(1)Relational operator

(2)Current date data

(3)Comparison result

- Set each data in binary.
- Set the year data in the range from 1980 to 2079 in the devices specified by (s1) and (s2).
- Set the month data in the range from 1 to 12 in the devices specified by (s1)+1 and (s2)+1.
- Set the date data in the range from 1 to 31 in the devices specified by (s1)+2 and (s2)+2.
- Set the following in (s3) as comparison target setting values. The following shows the bit configuration of (s3).



- (1) Set "day" as comparison target.
- (2) Set "month" as comparison target.
- (3) Set "year" as comparison target.
- (4) Set 0. If a value other than 0 is set, the operation result will be non-continuity.
- (5) When bit 15 turns on (1), the data in the device specified by (s1) is compared with the current date in accordance with the conditions set in bits 0 to 2.

- When 0 is set to bits 0 to 2, the date data are not compared. When 1 is set, the entire date data (year, month, and day) are compared.
- When 0 is set to bit 15, the data in the device specified by (s1) and the date data in the device specified by (s2) are compared. When 1 is set, the data in the device specified by (s1) is compared with the current date. The date data in the device specified by (s2) is ignored.

- The following table lists processing details of each bit.

| (s3) value when comparing two specified date data | (s3) value when comparing the specified date data with the current date | Comparison target | Description                                                                                                                                     |
|---------------------------------------------------|-------------------------------------------------------------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 0001H                                             | 8001H                                                                   | Day               | Only data in the device specified by (s1)+2 is compared.                                                                                        |
| 0002H                                             | 8002H                                                                   | Month             | Only data in the device specified by (s1)+1 is compared.                                                                                        |
| 0003H                                             | 8003H                                                                   | Month, day        | Data in the device areas specified by (s1)+1 and (s1)+2 are compared.                                                                           |
| 0004H                                             | 8004H                                                                   | Year              | Only data in the device specified by (s1) is compared.                                                                                          |
| 0005H                                             | 8005H                                                                   | Year, day         | Data in the device areas specified by (s1) and (s1)+2 are compared.                                                                             |
| 0006H                                             | 8006H                                                                   | Year, month       | Data in the device areas specified by (s1) and (s1)+1 are compared.                                                                             |
| 0007H                                             | 8007H                                                                   | Year, month, day  | The entire date data in the device areas specified by (s1), (s1)+1, and (s1)+2 are compared.                                                    |
| Other than 0001H to 0007H, 8001H to 8007H         |                                                                         | None              | The entire date data in the device areas specified by (s1), (s1)+1, and (s1)+2 are not compared. (The operation result will be non-continuity.) |

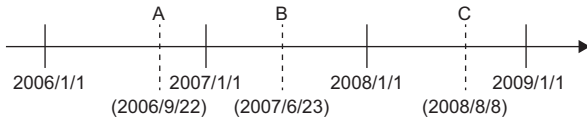
- If the comparison target data in the device are not recognized as date data, SM709 (DT/TM instruction improper data detection flag) turns on after the instruction is executed and the operation result will be non-continuity. Even if the data are not recognized as date data, SM709 does not turn on if the data are within the setting range. If the device areas specified by (s1) to (s1)+2 or (s2) to (s2)+2 exceed the assignment range of the relevant device/label, SM709 turns on after the instruction is executed and the operation result will be non-continuity as well. Once SM709 turns on, the on state is held until the controller is powered off or reset. Turn off SM709 as needed.
- The following table lists the comparison operation results of each instruction.

| Instruction symbol (ladder, FBD/LD) | Condition | Result                             |
|-------------------------------------|-----------|------------------------------------|
| DT=, EQ                             | (s1)=(s2) | Continuity state (ENO is on.)      |
| DT<>, NE                            | (s1)≠(s2) |                                    |
| DT>, GT                             | (s1)>(s2) |                                    |
| DT<=, LE                            | (s1)≤(s2) |                                    |
| DT<, LT                             | (s1)<(s2) |                                    |
| DT>=, GE                            | (s1)≥(s2) |                                    |
| DT=, EQ                             | (s1)≠(s2) | Non-continuity state (ENO is off.) |
| DT<>, NE                            | (s1)=(s2) |                                    |
| DT>, GT                             | (s1)≤(s2) |                                    |
| DT<=, LE                            | (s1)>(s2) |                                    |
| DT<, LT                             | (s1)≥(s2) |                                    |
| DT>=, GE                            | (s1)<(s2) |                                    |



**Ex.**

The date data A, B, and C are compared.



- The following table lists the comparison operation results between A, B, and C. Even when the data are compared under the same conditions, the results differ depending on the comparison target data.

| Comparison target data | Condition <sup>*1</sup> |                |                |
|------------------------|-------------------------|----------------|----------------|
|                        | A<B                     | B<C            | A<C            |
| Day                    | Continuity              | Non-continuity | Non-continuity |
| Month                  | Non-continuity          | Continuity     | Non-continuity |
| Month, day             | Non-continuity          | Continuity     | Non-continuity |
| Year                   | Continuity              | Continuity     | Continuity     |
| Year, day              | Continuity              | Continuity     | Continuity     |
| Year, month            | Continuity              | Continuity     | Continuity     |
| Year, month, day       | Continuity              | Continuity     | Continuity     |
| None                   | Non-continuity          | Non-continuity | Non-continuity |

<sup>\*1</sup> In FBD/LD, ENO ON indicates continuity and ENO OFF indicates non-continuity.

- Even though the specified date does not exist, the comparison operation is performed in accordance with the conditions in the following table as long as the date data are within the valid range.
  - Date A: 2006/02/30 (Even though the date does not exist, this date can be set.)
  - Date B: 2007/03/29
  - Date C: 2008/02/31 (Even though the date does not exist, this date can be set.)

| Comparison target data | Condition <sup>*2</sup> |                |                |
|------------------------|-------------------------|----------------|----------------|
|                        | A<B                     | B<C            | A<C            |
| Day                    | Non-continuity          | Continuity     | Continuity     |
| Month                  | Continuity              | Non-continuity | Non-continuity |
| Month, day             | Continuity              | Non-continuity | Continuity     |
| Year                   | Continuity              | Continuity     | Continuity     |
| Year, day              | Continuity              | Continuity     | Continuity     |
| Year, month            | Continuity              | Continuity     | Continuity     |
| Year, month, day       | Continuity              | Continuity     | Continuity     |
| None                   | Non-continuity          | Non-continuity | Non-continuity |

<sup>\*2</sup> In FBD/LD, ENO ON indicates continuity and ENO OFF indicates non-continuity.

- If the LDDT\_□ instruction is used in the program written in FBD/LD, use a left rail or a variable/constant which is always on for EN.
- If the ORDT\_□ instruction is used in the program written in FBD/LD and EN is set to TRUE, ENO turns on. EN will not be an execution condition.

## Operation error

There is no operation error.

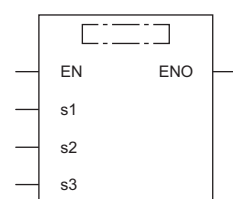
# Comparing time data

## LDTM□, ANDTM□, ORTM□

These instructions compare the specified time data, or compare the specified time data with the current time.

| Ladder                                                                          | ST                                                                                                                                                                             |
|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(□ is replaced by TM=, TM&lt;&gt;, TM&gt;, TM&lt;=, TM&lt;, or TM&gt;=.)</p> | <pre>ENO:=LDTM_□(EN,s1,s2,s3); ENO:=ANDTM_□(EN,s1,s2,s3); ENO:=ORTM_□(EN,s1,s2,s3);</pre> <p>(□ is replaced by any of the following: EQ, NE, GT, LE, LT, GE.)*<sup>1</sup></p> |

## FBD/LD



(□ is replaced by a combination of LDTM\_, ANDTM\_, or ORTM\_ and EQ, NE, GT, LE, LT, or GE.)\*<sup>1</sup>

\*<sup>1</sup> EQ indicates =, NE indicates <>, GT indicates >, LE indicates <=, LT indicates <, and GE indicates >=.

## Execution condition

| Instruction          | Execution condition |
|----------------------|---------------------|
| LDTM□, ANDTM□, ORTM□ | Every scan          |

## Setting data

## Description, range, data type

| Operand | Description                                                             | Range                             | Data type            | Data type (label)    |
|---------|-------------------------------------------------------------------------|-----------------------------------|----------------------|----------------------|
| (s1)    | Start device where the data to be compared is stored                    | —                                 | 16-bit signed binary | ANY_TM* <sup>1</sup> |
| (s2)    | Start device where the data to be compared is stored                    | —                                 | 16-bit signed binary | ANY_TM* <sup>1</sup> |
| (s3)    | Comparison target setting value or the number of comparison target data | 0001H to 0007H,<br>8001H to 8007H | 16-bit signed binary | ANY16                |
| EN      | Execution condition                                                     | —                                 | Bit                  | BOOL                 |
| ENO     | Execution result                                                        | —                                 | Bit                  | BOOL                 |

\*<sup>1</sup> When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

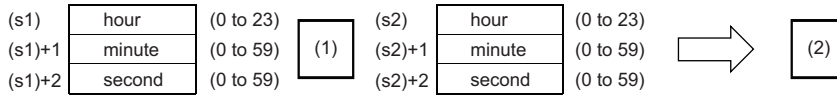
| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (s3)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

- These instructions compare the time data in the device specified by (s1) and (s2), or compare the time data in the device specified by (s1) with the current time. Set the comparison target by (s3).

- Comparing two specified time data

These instructions compare the time data in the device specified by (s1) with the time data (hour, minute, second) in the device specified by (s2) in accordance with the conditions set by (s3). (Devices are used as a normally open contact.)

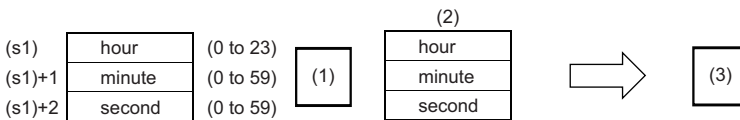


(1)Relational operator

(2)Comparison result

- Comparing the specified time data with the current time data

These instructions compare the time data in the device specified by (s1) with the current time data in accordance with the conditions set by (s3). (Devices are used as a normally open contact.) The time data in the device specified by (s2) is regarded as dummy data and ignored.

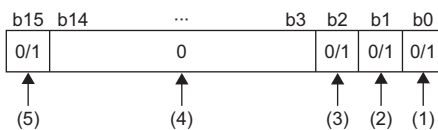


(1)Relational operator

(2)Current time data

(3)Comparison result

- Set each data in binary.
- Set the hour data in the range from 0 to 23 in 24-hour format in the devices specified by (s1) and (s2).
- Set the minute data in the range from 0 to 59 in the devices specified by (s1)+1 and (s2)+1.
- Set the second data in the range from 0 to 59 in the devices specified by (s1)+2 and (s2)+2.
- Set the following in (s3) as comparison target setting values. The following shows the bit configuration of (s3).



- (1) Set "second" as comparison target.
- (2) Set "minute" as comparison target.
- (3) Set "hour" as comparison target.
- (4) Set 0. If a value other than 0 is set, the operation result will be non-continuity.
- (5) When bit 15 turns on (1), the data in the device specified by (s1) is compared with the current time in accordance with the conditions set in bits 0 to 2.

- When 0 is set to bits 0 to 2, the time data are not compared. When 1 is set, the comparison target time data (hour, minute, second) are compared.
- When 0 is set to bit 15, the data in the device specified by (s1) and the time data in the device specified by (s2) are compared. When 1 is set, the time data in the device specified by (s1) is compared with the current time. The time data in the device specified by (s2) is ignored.
- The following table lists processing details of each bit.

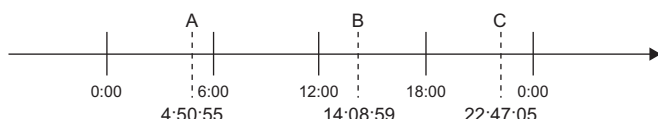
| (s3) value when comparing two specified time data | (s3) value when comparing with current time data | Comparison target time | Description                                                                                                                                     |
|---------------------------------------------------|--------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 0001H                                             | 8001H                                            | Second                 | Only data in the device specified by (s1)+2 is compared.                                                                                        |
| 0002H                                             | 8002H                                            | Minute                 | Only data in the device specified by (s1)+1 is compared.                                                                                        |
| 0003H                                             | 8003H                                            | Minute, second         | Data in the device areas specified by (s1)+1 and (s1)+2 are compared.                                                                           |
| 0004H                                             | 8004H                                            | Hour                   | Only data in the device specified by (s1) is compared.                                                                                          |
| 0005H                                             | 8005H                                            | Hour, second           | Data in the device areas specified by (s1) and (s1)+2 are compared.                                                                             |
| 0006H                                             | 8006H                                            | Hour, minute           | Data in the device areas specified by (s1) and (s1)+1 are compared.                                                                             |
| 0007H                                             | 8007H                                            | Hour, minute, second   | The entire date data in the device areas specified by (s1), (s1)+1, and (s1)+2 are compared.                                                    |
| Other than 0001H to 0007H, 8001H to 8007H         |                                                  | None                   | The entire date data in the device areas specified by (s1), (s1)+1, and (s1)+2 are not compared. (The operation result will be non-continuity.) |

- If the comparison target data in the device are not recognized as time data, SM709 (DT/TM instruction improper data detection flag) turns on after the instruction is executed and the operation result will be non-continuity (ENO OFF). If the device areas specified by (s1) to (s1)+2 or (s2) to (s2)+2 exceed the assignment range of the relevant device/label, SM709 turns on after the instruction is executed and the operation result will be non-continuity (ENO OFF) as well. Once SM709 turns on, the on state is held until the controller is powered off or reset. Turn off SM709 as needed.
- The following table lists the comparison operation results of each instruction.

| Instruction symbol (ladder, FBD/LD) | Condition | Result                             |
|-------------------------------------|-----------|------------------------------------|
| TM=, EQ                             | (s1)=(s2) | Continuity state (ENO is on.)      |
| TM<>, NE                            | (s1)≠(s2) |                                    |
| TM>, GT                             | (s1)>(s2) |                                    |
| TM<=, LE                            | (s1)≤(s2) |                                    |
| TM<, LT                             | (s1)<(s2) |                                    |
| TM>=, GE                            | (s1)≥(s2) |                                    |
| TM=, EQ                             | (s1)≠(s2) | Non-continuity state (ENO is off.) |
| TM<>, NE                            | (s1)=(s2) |                                    |
| TM>, GT                             | (s1)≤(s2) |                                    |
| TM<=, LE                            | (s1)>(s2) |                                    |
| TM<, LT                             | (s1)≥(s2) |                                    |
| TM>=, GE                            | (s1)<(s2) |                                    |

#### Ex.

The time data A, B, and C are compared.



- The following table lists the comparison operation results between A, B, and C. Even when the data are compared under the same conditions, the results differ depending on the comparison target data.

| Comparison target data | Condition <sup>*1</sup> |                |                |
|------------------------|-------------------------|----------------|----------------|
|                        | A<B                     | B<C            | A<C            |
| Second                 | Continuity              | Non-continuity | Non-continuity |
| Minute                 | Non-continuity          | Continuity     | Non-continuity |
| Minute, second         | Non-continuity          | Continuity     | Non-continuity |
| Hour                   | Continuity              | Continuity     | Continuity     |
| Hour, second           | Continuity              | Continuity     | Continuity     |
| Hour, minute           | Continuity              | Continuity     | Continuity     |
| Hour, minute, second   | Continuity              | Continuity     | Continuity     |
| None                   | Non-continuity          | Non-continuity | Non-continuity |

<sup>\*1</sup> In FBD/LD, ENO ON indicates continuity and ENO OFF indicates non-continuity.

- If the LDTM\_□ instruction is used in the program written in FBD/LD, use a left rail or a variable/constant which is always on for EN.
- If the ORTM\_□ instruction is used in the program written in FBD/LD and EN is set to TRUE, ENO turns on. EN will not be an execution condition.

## Operation error

There is no operation error.

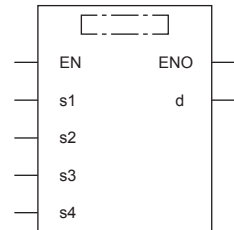
# Outputting a comparison result of time data

## TCMP(P)

These instructions compare the time data to be compared that is specified by (s1), (s2), and (s3) with the time data specified by (s4), and according to the result (small, match, or large), (d), (d)+1, or (d)+2 is turned on.

| Ladder | ST                                                            |
|--------|---------------------------------------------------------------|
|        | ENO:=TCMP(EN,s1,s2,s3,s4,d);<br>ENO:=TCMPP(EN,s1,s2,s3,s4,d); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| TCMP        |                     |
| TCMPP       |                     |

## Setting data

## Description, range, data type

| Operand | Description                                                                  | Range   | Data type            | Data type (label)                       |
|---------|------------------------------------------------------------------------------|---------|----------------------|-----------------------------------------|
| (s1)    | Start device for storing the time data (hour) to be compared                 | 0 to 23 | 16-bit signed binary | ANY16                                   |
| (s2)    | Start device for storing the time data (minute) to be compared               | 0 to 59 | 16-bit signed binary | ANY16                                   |
| (s3)    | Start device for storing the time data (second) to be compared               | 0 to 59 | 16-bit signed binary | ANY16                                   |
| (s4)    | Start device for storing the time data (hour, minute, second) to be compared | —       | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 3)  |
| (d)     | The start device where the comparison result is stored                       | —       | Bit                  | ANYBIT_ARRAY<br>(Number of elements: 3) |
| EN      | Execution condition                                                          | —       | Bit                  | BOOL                                    |
| ENO     | Execution result                                                             | —       | Bit                  | BOOL                                    |

## Applicable devices

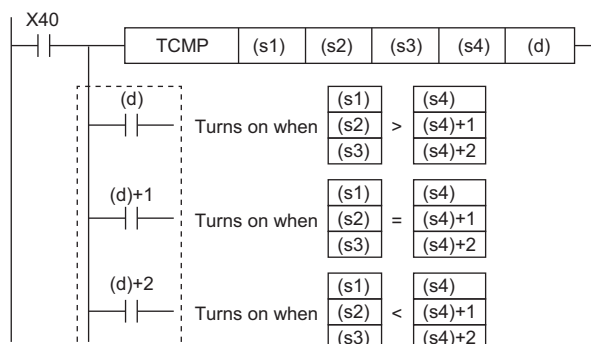
| Operand | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○*1                              | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○*1                              | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s3)    | ○*1                              | ○   | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s4)    | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | ○                                | —   | ○*2                                   | —           | — | —           | —  | —                      | —        | — | —  | —      |

\*1 FX and FY cannot be used.

\*2 T, ST, and C cannot be used.

## Processing details

- These instructions compare the time data to be compared that is specified by (s1), (s2), and (s3) with the time data specified by (s4), and according to the result (small, match, or large), (d), (d)+1, or (d)+2 is turned on.



- (s1): hour, (s2): minute, (s3): second
- (s4): hour, (s4)+1: minute, (s4)+2: second

## Operation error

| Error code (SD0) | Description                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------|
| 3285H            | The value specified by (s1) and (s4) is outside the following range.<br>0 to 23                  |
|                  | The value specified by (s2), (s3), (s4)+1, and (s4)+2 is outside the following range.<br>0 to 59 |

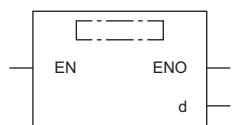
# Reading expansion clock data

21

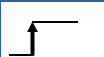
## S(P).DATERD

These instructions read clock data including millisecond from the clock elements in the controller.

| Ladder                                                                            | ST                                            |
|-----------------------------------------------------------------------------------|-----------------------------------------------|
|  | ENO:=S_DATERD(EN,d);<br>ENO:=SP_DATERD(EN,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| S.DATERD    |  |
| SP.DATERD   |  |

### Setting data

### Description, range, data type

| Operand | Description                                                | Range | Data type            | Data type (label)                      |
|---------|------------------------------------------------------------|-------|----------------------|----------------------------------------|
| (d)     | Start device for storing the clock data that has been read | —     | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 8) |
| EN      | Execution condition                                        | —     | Bit                  | BOOL                                   |
| ENO     | Execution result                                           | —     | Bit                  | BOOL                                   |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            | Z | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | — | —      |

## Processing details

- These instructions read "year, month, day, hour, minute, second, day of week, and 1/1000 second" from the clock element of the controller, and store the read data in binary in the device specified by (d) and later.

| (Data)          | (d)          | (d)+1   | (d)+2   | (d)+3   | (d)+4   | (d)+5   | (d)+6       | (d)+7       |
|-----------------|--------------|---------|---------|---------|---------|---------|-------------|-------------|
| (Clock element) | Year         | Month   | Day     | Hour    | Minute  | Second  | Day of week | Millisecond |
| (Setting range) | 1980 to 2079 | 1 to 12 | 1 to 31 | 0 to 23 | 0 to 59 | 0 to 59 | 0 to 6      | 0 to 999    |

- "Year" stored in the device specified by (d) is a 4-digit year.
- "Day of week" stored in the device specified by (d)+6 is a number from 0 to 6 corresponding to Sunday to Saturday.

| Day of week | Day | Month | Tuesday | Wednesday | Thursday | Friday | Saturday |
|-------------|-----|-------|---------|-----------|----------|--------|----------|
| Stored data | 0   | 1     | 2       | 3         | 4        | 5      | 6        |

- Data is automatically corrected in leap years.

## Precautions

- S(P).DATERD instruction reads clock data and store it in the device even when incorrect clock data is set in the controller. (Example: February 30) When setting clock data with the DATEWR(P) instruction or engineering tool, be careful not to set incorrect clock data.
- When millisecond clock data is read, the maximum error is 2ms. (This error means the difference between the data stored in clock elements in the controller and the data read by the S(P).DATERD instruction.)

## Operation error

There is no operation error.



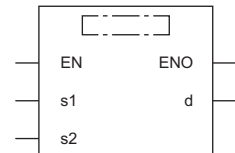
# Adding expansion clock data

## S(P).DATE+

These instructions add time data.

| Ladder | ST                                                                    |
|--------|-----------------------------------------------------------------------|
|        | <pre>ENO:=S_DATEPLUS(EN,s1,s2,d); ENO:=SP_DATEPLUS(EN,s1,s2,d);</pre> |

## FBD/LD



(□ is replaced by either of the following: S\_DATEPLUS, SP\_DATEPLUS.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| S.DATE+     |                     |
| SP.DATE+    |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                    | Range                          | Data type            | Data type (label)                      |
|---------|----------------------------------------------------------------|--------------------------------|----------------------|----------------------------------------|
| (s1)    | Start device where the augend clock data is stored             | Refer to "Processing details". | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 5) |
| (s2)    | Start device where the addend time (clock) data is stored      | Refer to "Processing details". | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 5) |
| (d)     | Start device for storing the addition result time (clock) data | —                              | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 5) |
| EN      | Execution condition                                            | —                              | Bit                  | BOOL                                   |
| ENO     | Execution result                                               | —                              | Bit                  | BOOL                                   |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions add the time data in the device specified by (s2) to the time data in the device specified by (s1), and store the addition result in the device number specified by (d) and later.

|        |              |            |        |              |            |       |              |            |
|--------|--------------|------------|--------|--------------|------------|-------|--------------|------------|
| (s1)   | hour         | (0 to 23)  | (s2)   | hour         | (0 to 23)  | (d)   | hour         | (0 to 23)  |
| (s1)+1 | minute       | (0 to 59)  | (s2)+1 | minute       | (0 to 59)  | (d)+1 | minute       | (0 to 59)  |
| (s1)+2 | second       | (0 to 59)  | (s2)+2 | second       | (0 to 59)  | (d)+2 | second       | (0 to 59)  |
| (s1)+3 | —            |            | (s2)+3 | —            |            | (d)+3 | —            |            |
| (s1)+4 | 1/1000second | (0 to 999) | (s2)+4 | 1/1000second | (0 to 999) | (d)+4 | 1/1000second | (0 to 999) |

### Ex.

7:48:10:500 is added to 6:32:40:875.

|        |     |        |     |       |     |
|--------|-----|--------|-----|-------|-----|
| (s1)   | 6   | (s2)   | 7   | (d)   | 14  |
| (s1)+1 | 32  | (s2)+1 | 48  | (d)+1 | 20  |
| (s1)+2 | 40  | (s2)+2 | 10  | (d)+2 | 51  |
| (s1)+3 | —   | (s2)+3 | —   | (d)+3 | —   |
| (s1)+4 | 875 | (s2)+4 | 500 | (d)+4 | 375 |

- If the time obtained as the result of addition exceeds 24 hours, 24 hours are subtracted from the resultant time to produce the operation result. For example, when 20:20:20:500 is added to 14:20:30:875, the operation result is 10:40:51:375 rather than 34:40:51:375.

|        |     |        |     |       |     |
|--------|-----|--------|-----|-------|-----|
| (s1)   | 14  | (s2)   | 20  | (d)   | 10  |
| (s1)+1 | 20  | (s2)+1 | 20  | (d)+1 | 40  |
| (s1)+2 | 30  | (s2)+2 | 20  | (d)+2 | 51  |
| (s1)+3 | —   | (s2)+3 | —   | (d)+3 | —   |
| (s1)+4 | 875 | (s2)+4 | 500 | (d)+4 | 375 |

## Point

- Devices (s1)+3, (s2)+3, and (d)+3 are not used for operation.
- The clock data that has been read by the S(P).DATERD instruction can be added without conversion.

|       |             |
|-------|-------------|
| (d)   | Hour        |
| (d)+1 | Minute      |
| (d)+2 | Second      |
| (d)+3 | Day of week |
| (d)+4 | Millisecond |

When clock data is read by the S(P).DATERD instruction, "day of week" is inserted between "second" and "millisecond".

If the S(P).DATE+ instruction is used to read clock data, the data can be directly used for addition since it does not perform calculation for the day of week.

## Operation error

| Error code (SD0) | Description                                                       |
|------------------|-------------------------------------------------------------------|
| 3285H            | The data in the device specified by (s1) or (s2) is out of range. |

# Subtracting expansion clock data

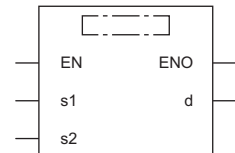
21

## S(P).DATE-

These instructions subtract time data.

| Ladder | ST                                                                      |
|--------|-------------------------------------------------------------------------|
|        | <pre>ENO:=S_DATEMINUS(EN,s1,s2,d); ENO:=SP_DATEMINUS(EN,s1,s2,d);</pre> |

## FBD/LD



(□ is replaced by either of the following: S\_DATEMINUS, SP\_DATEMINUS.)

## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| S.DATE-     |                     |
| SP.DATE-    |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                       | Range                          | Data type            | Data type (label)                      |
|---------|-------------------------------------------------------------------|--------------------------------|----------------------|----------------------------------------|
| (s1)    | Start device where minuend clock data is stored                   | Refer to "Processing details". | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 5) |
| (s2)    | Start device where the subtrahend time (clock) data is stored     | Refer to "Processing details". | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 5) |
| (d)     | Start device for storing the subtraction result time (clock) data | —                              | 16-bit signed binary | ANY16_ARRAY<br>(Number of elements: 5) |
| EN      | Execution condition                                               | —                              | Bit                  | BOOL                                   |
| ENO     | Execution result                                                  | —                              | Bit                  | BOOL                                   |

## Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (d)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions subtract the time data in the device specified by (s2) from the time data in the device specified by (s1), and store the subtraction result in the device number specified by (d) and later.

|        |              |            |        |              |            |       |              |            |
|--------|--------------|------------|--------|--------------|------------|-------|--------------|------------|
| (s1)   | hour         | (0 to 23)  | (s2)   | hour         | (0 to 23)  | (d)   | hour         | (0 to 23)  |
| (s1)+1 | minute       | (0 to 59)  | (s2)+1 | minute       | (0 to 59)  | (d)+1 | minute       | (0 to 59)  |
| (s1)+2 | second       | (0 to 59)  | (s2)+2 | second       | (0 to 59)  | (d)+2 | second       | (0 to 59)  |
| (s1)+3 | —            |            | (s2)+3 | —            |            | (d)+3 | —            |            |
| (s1)+4 | 1/1000second | (0 to 999) | (s2)+4 | 1/1000second | (0 to 999) | (d)+4 | 1/1000second | (0 to 999) |

### Ex.

3:50:10:500 is subtracted from 10:40:20:875.

|        |     |        |     |       |     |
|--------|-----|--------|-----|-------|-----|
| (s1)   | 10  | (s2)   | 3   | (d)   | 6   |
| (s1)+1 | 40  | (s2)+1 | 50  | (d)+1 | 50  |
| (s1)+2 | 20  | (s2)+2 | 10  | (d)+2 | 10  |
| (s1)+3 | —   | (s2)+3 | —   | (d)+3 | —   |
| (s1)+4 | 875 | (s2)+4 | 500 | (d)+4 | 375 |

- If the time obtained as the result of subtraction becomes a negative value, 24 hours are added to the resultant time to produce the operation result. For example, when 10:42:12:500 is subtracted from 4:50:32:875, the operation result is 18:8:20:375 rather than -6:8:20:375.

|        |     |        |     |       |     |
|--------|-----|--------|-----|-------|-----|
| (s1)   | 4   | (s2)   | 10  | (d)   | 18  |
| (s1)+1 | 50  | (s2)+1 | 42  | (d)+1 | 8   |
| (s1)+2 | 32  | (s2)+2 | 12  | (d)+2 | 20  |
| (s1)+3 | —   | (s2)+3 | —   | (d)+3 | —   |
| (s1)+4 | 875 | (s2)+4 | 500 | (d)+4 | 375 |

## Point

- Devices (s1)+3, (s2)+3, and (d)+3 are not used for operation.
- The clock data that has been read by the S(P).DATERD instruction can be subtracted without conversion.

|       |             |
|-------|-------------|
| (d)   | Hour        |
| (d)+1 | Minute      |
| (d)+2 | Second      |
| (d)+3 | Day of week |
| (d)+4 | Millisecond |

When clock data is read by the S(P).DATERD instruction, "day of week" is inserted between "second" and "millisecond".

If the S(P).DATE- instruction is used to read clock data, the data can be directly used for subtraction since it does not perform calculation for the day of week.

## Operation error

| Error code (SD0) | Description                                                       |
|------------------|-------------------------------------------------------------------|
| 3285H            | The data in the device specified by (s1) or (s2) is out of range. |

## 21.2 Timing Check Instructions

### Generating timing pulses

#### DUTY

This instruction turns on the user timing clock for the specified number of scans and off for the specified number of scans.

| Ladder | ST                     |
|--------|------------------------|
|        | ENO:=DUTY(EN,n1,n2,d); |

| FBD/LD |
|--------|
|        |

#### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| DUTY        |                     |

#### Setting data

#### Descriptions, ranges, and data types

| Operand | Description                                                     | Range          | Data type              | Data type (label)      |
|---------|-----------------------------------------------------------------|----------------|------------------------|------------------------|
| (n1)    | Number of scans during which the clock is turned on             | 0 to 65535     | 16-bit unsigned binary | ANY16                  |
| (n2)    | Number of scans during which the clock is turned off            | 0 to 65535     | 16-bit unsigned binary | ANY16                  |
| (d)     | Special relay device number of user timing clock to be operated | SM420 to SM424 | Bit                    | ANY_BOOL <sup>*1</sup> |
| EN      | Execution condition                                             | —              | Bit                    | BOOL                   |
| ENO     | Execution result                                                | —              | Bit                    | BOOL                   |

<sup>\*1</sup> Only labels assigned to SM420 to SM424 can be used.

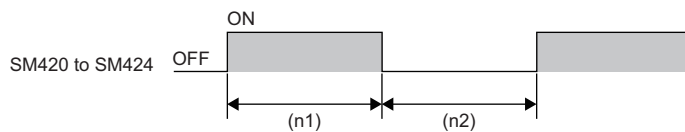
#### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (n1)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (n2)    | ○                                | ○   | ○                                     | ○          | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○ <sup>*1</sup>                  | —   | —                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |

<sup>\*1</sup> Only SM420 to SM424 can be used.

## Processing details

- This instruction turns on SM420 to SM424 in the device specified by (d) for the number of scans specified by (n1) and turns it off for the number of scans specified by (n2).



(n1): (n1) scans

(n2): (n2) scans

- The scan execution type program uses SM420 to SM424.
- When 0 is specified in (n1) and (n2) is equal to or greater than 0, SM420 to SM424 stay off. When (n1) is greater than 0 and (n2) is 0, SM420 to SM424 stay on.
- When the DUTY instruction is executed, the data specified by (n1), (n2), and (d) is stored in the system, and the timing pulses are turned on or off by the END processing.

## Operation error

| Error code (SD0) | Description                                               |
|------------------|-----------------------------------------------------------|
| 2820H            | The device other than SM420 to SM424 is specified by (d). |

## Measuring time of the specified data

### TIMCHK

This instruction measures the on time of the device and, if the on time has continued as specified or longer, turns on the specified device.

| Ladder | ST                       |
|--------|--------------------------|
|        | ENO:=TIMCHK(EN,s1,s2,d); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| TIMCHK      |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                                                         | Range      | Data type            | Data type (label) |
|---------|-----------------------------------------------------------------------------------------------------|------------|----------------------|-------------------|
| (s1)    | Device for storing the current value measured (unit: 100ms)                                         | —          | 16-bit signed binary | ANY16             |
| (s2)    | Set value for measurement or the device where the set value for measurement is stored (unit: 100ms) | 0 to 32767 | 16-bit signed binary | ANY16             |
| (d)     | Device to be turned on at time-up                                                                   | —          | Bit                  | ANY_BOOL          |
| EN      | Execution condition                                                                                 | —          | Bit                  | BOOL              |
| ENO     | Execution result                                                                                    | —          | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |
| (s2)    | ○                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- This instruction measures the on time of the device and, if the on time has continued as specified in the device specified by (s2) or longer, turns on the device specified by (d).
- The current value in the device specified by (s1) is cleared to 0 and the device specified by (d) is turned off on the rising edge of the execution command. The current value in the device specified by (s1) and the on state of the device specified by (d) are retained even after the execution command turns off.
- The current value measured is stored in units of 100ms. Set the measurement time in increments of 100ms.
- If 0 is specified in (s2), the current value in the device specified by (s1) is cleared to 0 and the device specified by (d) is turned off on the rising edge of the execution command.
- If a number other than 0 to 32767 is specified in (s2), (d) is turned on at the next scan after the execution command turns on.

## Operation error

There is no operation error.



# 22 MODULE ACCESS

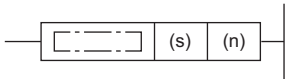
22

## 22.1 Module Access Instructions

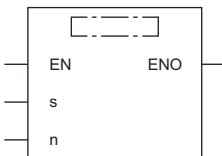
### Performing I/O refresh

#### RFS(P)

These instructions refresh the n points of data from the specified device, and import external inputs or output data to the output module.

| Ladder                                                                            | ST                                      |
|-----------------------------------------------------------------------------------|-----------------------------------------|
|  | ENO:=RFS(EN,s,n);<br>ENO:=RFSP(EN,s,n); |

#### FBD/LD



#### ■Execution condition

| Instruction | Execution condition                                                                 |
|-------------|-------------------------------------------------------------------------------------|
| RFS         |  |
| RFSP        |  |

#### Setting data

#### ■Descriptions, ranges, and data types

| Operand | Description                  | Range     | Data type              | Data type (label) |
|---------|------------------------------|-----------|------------------------|-------------------|
| (s)     | Start device to be refreshed | —         | Bit                    | ANY_BOOL*1        |
| (n)     | Number of refreshed points   | 1 to 4096 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition          | —         | Bit                    | BOOL              |
| ENO     | Execution result             | —         | Bit                    | BOOL              |

\*1 Only labels assigned to devices (X, Y) can be used.

#### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○*1                              | —    | —                                     | —           | — | —           | —  | —                      | —        | — | —  | —      |
| (n)     | —                                | ○    | ○                                     | ○           | ○ | —           | —  | ○                      | ○        | — | —  | —      |

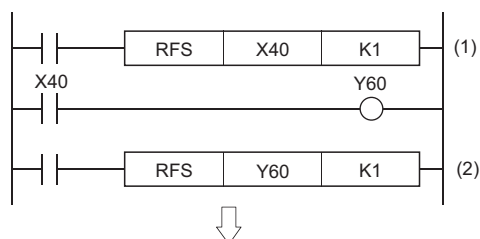
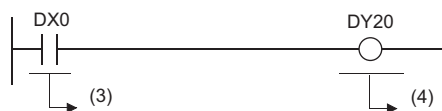
\*1 Only X and Y can be used.

## Processing details

- This instruction refreshes only the relevant device during one scan, and imports external inputs or outputs data to the output module.
- The instruction imports external inputs and outputs data to the outside altogether only after execution of the END instruction of the program, and therefore cannot output pulse signals to the outside during one scan. When executed, the I/O refresh instruction forcibly refreshes the relevant input (X) and output (Y) during program execution and therefore can output pulse signals to the outside during one scan.
- To refresh the input (X) or output (Y) in units of points, use the direct access input (DX) or direct access output (DY).

### Ex.

When a program using the RFS instruction is changed to a program using direct access input/output



- (1) Refresh X40.  
 (2) Refresh Y60.  
 (3) Direct access input  
 (4) Direct access output

## Operation error

| Error code (SD0) | Description                                                                                     |
|------------------|-------------------------------------------------------------------------------------------------|
| 2820H            | The range of (n) points from the device specified by (s) exceeds the range of the proximal I/O. |

# Reading 1-word/2-word data from another module (16-bit specification)

## FROM(P), DFROM(P)

### • FROM(P):

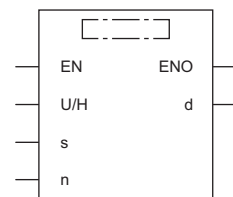
This instruction reads n words of data from the buffer memory address in the specified module.

### • DFROM(P):

This instruction reads n×2 words of data from the buffer memory address in the specified module.

| Ladder | ST                                                                                                               |
|--------|------------------------------------------------------------------------------------------------------------------|
|        | ENO:=FROM(EN,U/H,s,n,d);<br>ENO:=FROMP(EN,U/H,s,n,d);<br>ENO:=DFROM(EN,U/H,s,n,d);<br>ENO:=DFROMP(EN,U/H,s,n,d); |

## FBD/LD



## ■Execution condition

| Instruction     | Execution condition |
|-----------------|---------------------|
| FROM<br>DFROM   |                     |
| FROMP<br>DFROMP |                     |

## Setting data

## ■Description, range, data type

| Operand | Description                                                                          | Range                     | Data type              | Data type (label)   |
|---------|--------------------------------------------------------------------------------------|---------------------------|------------------------|---------------------|
| (U/H)   | Intelligent module No.                                                               | 1H to 10H, 3E0H, 40H, 42H | 16-bit unsigned binary | ANY16               |
| (s)     | Start address of buffer memory or CPU built-in memory containing the data to be read | 0 to 65535                | 16-bit unsigned binary | ANY16               |
| (d)     | FROM(P)<br>DFROM(P)                                                                  | —                         | 16-bit signed binary   | ANY16 <sup>*1</sup> |
|         |                                                                                      |                           | 32-bit signed binary   | ANY32 <sup>*1</sup> |
| (n)     | Number of read data                                                                  | 0 to 65535                | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                                                  | —                         | Bit                    | BOOL                |
| ENO     | Execution result                                                                     | —                         | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## ■Applicable devices

| Operand | Bit                              |      | Word                                  |            |   | Double word     |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|------|---------------------------------------|------------|---|-----------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□□ | Z | LT, LST, LC     | LZ |                        | K, H     | E | \$ |            |
| (U/H)   | ○                                | ○    | ○                                     | ○          | ○ | —               | —  | ○                      | ○        | — | —  | ○          |
| (s)     | ○                                | ○    | ○                                     | ○          | ○ | —               | —  | ○                      | ○        | — | —  | —          |
| (d)     | ○                                | —    | ○                                     | —          | — | ○ <sup>*1</sup> | —  | ○                      | —        | — | —  | —          |
| (n)     | ○                                | ○    | ○                                     | ○          | ○ | —               | —  | ○                      | ○        | — | —  | —          |

\*1 Only the DFROM(P) instruction can be used.

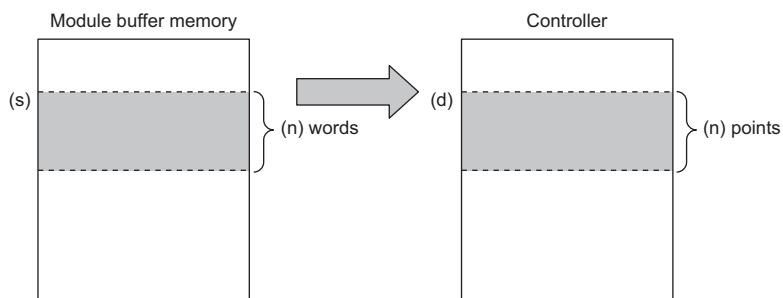
## Processing details

Specify the intelligent module numbers of the controller as shown in the table below.

| Controller                     | Intelligent module No. |
|--------------------------------|------------------------|
| CPU function part              | 3E0H                   |
| Built-in network function part | 40H                    |
| Built-in motion function part  | 42H                    |

### ■FROM(P)

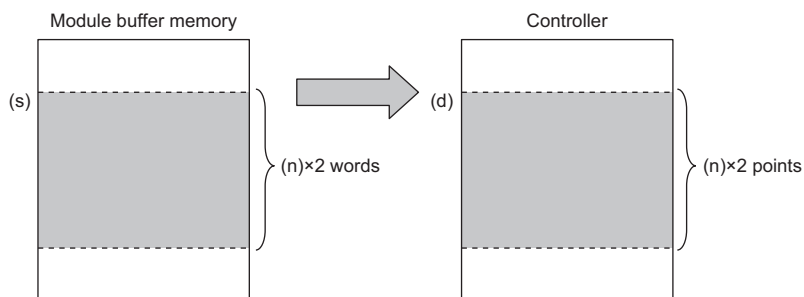
- This instruction reads (n) words of data from the buffer memory address specified by (s) in the module specified by (U/H), and stores in the device specified by (d) and later.



- If the read data (n) is 0, no processing is performed.
- An instruction which has been executed will result in non-processing if it fails to access the target module because the module is faulty or busy in processing.

### ■DFROM(P)

- This instruction reads (n)×2 words of data from the buffer memory address specified by (s) in the module specified by (U/H), and stores in the device specified by (d) and later.

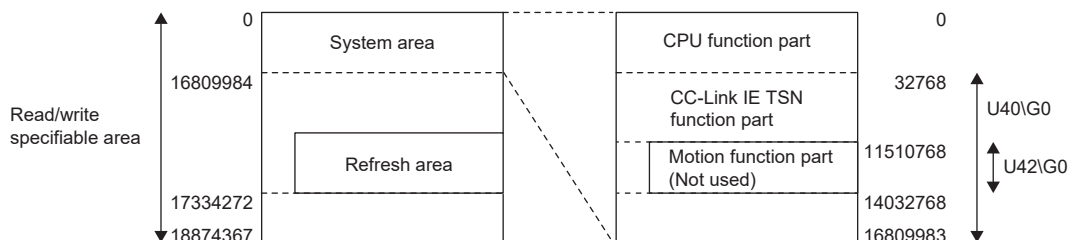


- If the read data (n) is 0, no processing is performed.
- An instruction which has been executed will result in non-processing if it fails to access the target module because the module is faulty or busy in processing.

| Error code (SD0) | Description                                                                                                                        |
|------------------|------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | The module with the I/O number specified by (U) does not have buffer memory.                                                       |
| 2823H            | The module with the I/O number specified by (H) does not have buffer memory.                                                       |
|                  | The address specified by (s) is outside the range of buffer memory.                                                                |
|                  | The (n) points of data starting from the address specified by (s) are outside the range of buffer memory. (FROM(P) instruction)    |
|                  | The 2×(n) points of data starting from the address specified by (s) are outside the range of buffer memory. (DFROM(P) instruction) |
| 3602H            | This instruction is executed for the intelligent module in an interrupt program with the priority 1 to 16.                         |

## Point

- Module data can also be read using the module access device. (📖User's manual for the controller used)
- If refresh settings are not made for the refresh area of the read/write enabled area in the CPU buffer memory, the area can be used as a read/write specifiable area. Even when refresh settings are made, the area can be used as a read/write specifiable area in the reference send range and later. If the intelligent module number U40\G0 or U42\G0 of the CC-Link IE TSN function part or motion function part is specified in the operand (U/H), the following range can be accessed.



- A CPU buffer memory access device can be used to read data from the CPU buffer memory. (📖User's manual for the controller used)
- The FROM(P) and DFROM(P) instructions can read data from the buffer memory address with a capacity of 64K words or less. To read data from the buffer memory address with a capacity exceeding 64K words, use the FROMD(P) or DFROMD(P) instruction. (📖Page 1017 FROMD(P), DFROMD(P))

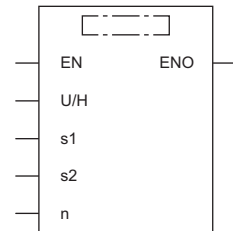
# Writing 1-word/2-word data to a module (16-bit specification)

## TO(P), DTO(P)

- TO(P): This instruction writes the n points of data from the specified device to the buffer memory in the module.
- DTO(P): This instruction writes the n×2 points of data from the specified device to the buffer memory in the module.

| Ladder | ST                                                                                                               |
|--------|------------------------------------------------------------------------------------------------------------------|
|        | ENO:=TO(EN,U/H,s1,s2,n);<br>ENO:=TOP(EN,U/H,s1,s2,n);<br>ENO:=DTO(EN,U/H,s1,s2,n);<br>ENO:=DTOP(EN,U/H,s1,s2,n); |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| TO<br>DTO   |                     |
| TOP<br>DTOP |                     |

## Setting data

### Description, range, data type

| Operand | Description                                                                          | Range                     | Data type              | Data type (label)   |
|---------|--------------------------------------------------------------------------------------|---------------------------|------------------------|---------------------|
| (U/H)   | Intelligent module No.                                                               | 1H to 10H, 3E0H, 40H, 42H | 16-bit unsigned binary | ANY16               |
| (s1)    | Start address of buffer memory or CPU built-in memory to which data is to be written | 0 to 65535                | 16-bit unsigned binary | ANY16               |
| (s2)    | TO(P)<br>Write data or the start device where the write data is stored               | -32768 to 32767           | 16-bit signed binary   | ANY16 <sup>*1</sup> |
|         |                                                                                      | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32 <sup>*1</sup> |
| (n)     | Number of write data                                                                 | 0 to 65535                | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                                                  | —                         | Bit                    | BOOL                |
| ENO     | Execution result                                                                     | —                         | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word     |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-----------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC     | LZ |                        | K, H     | E | \$ |            |
| (U/H)   | ○                                | ○   | ○                                     | ○          | ○ | —               | —  | ○                      | ○        | — | —  | ○          |
| (s1)    | ○                                | ○   | ○                                     | ○          | ○ | —               | —  | ○                      | ○        | — | —  | —          |
| (s2)    | ○                                | —   | ○                                     | —          | — | ○ <sup>*1</sup> | —  | ○                      | ○        | — | —  | —          |
| (n)     | ○                                | ○   | ○                                     | ○          | ○ | —               | —  | ○                      | ○        | — | —  | —          |

\*1 Only the DTO(P) instruction can be used.

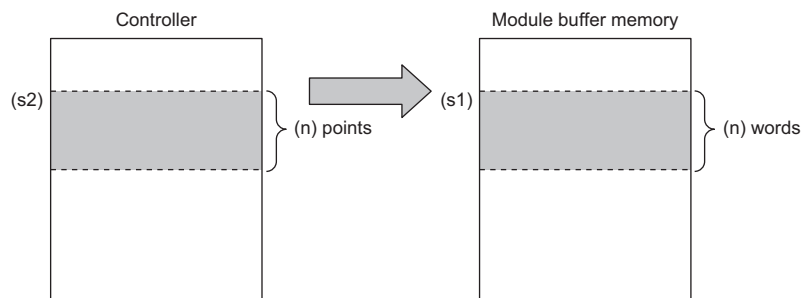
## Processing details

Specify the intelligent module numbers of the controller as shown in the table below.

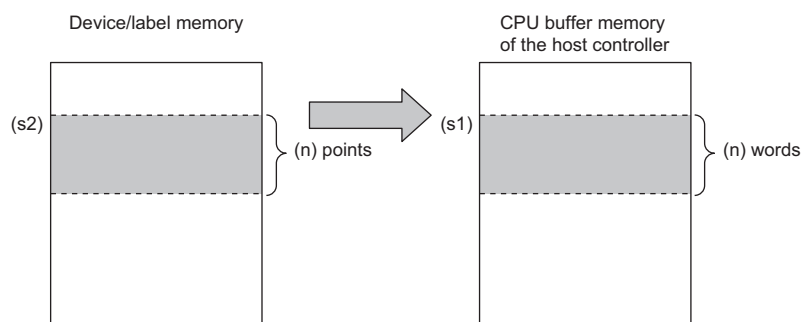
| Controller                     | Intelligent module No. |
|--------------------------------|------------------------|
| CPU function part              | 3E0H                   |
| Built-in network function part | 40H                    |
| Built-in motion function part  | 42H                    |

### ■TO(P)

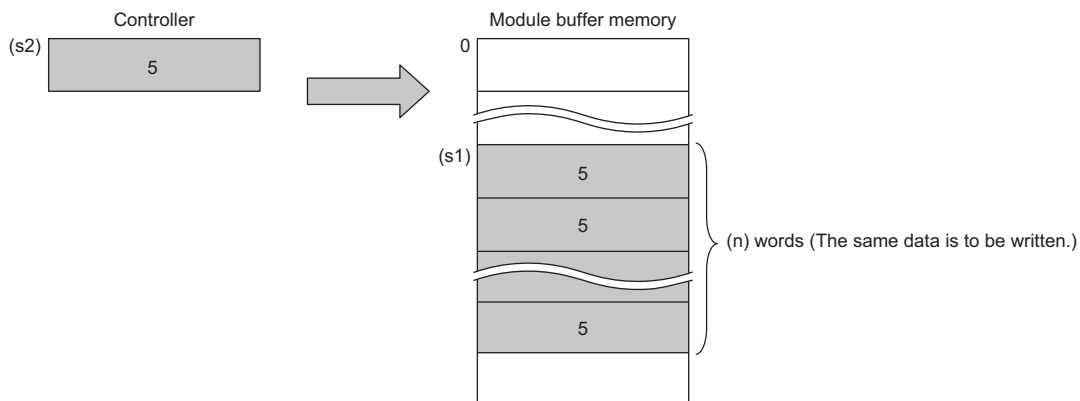
- This instruction writes the  $n$  points of data from the device specified by (s2) to the buffer memory address specified by (s1) and later in the buffer memory in the module or host controller specified by (U/H).
- Writing word data to a module



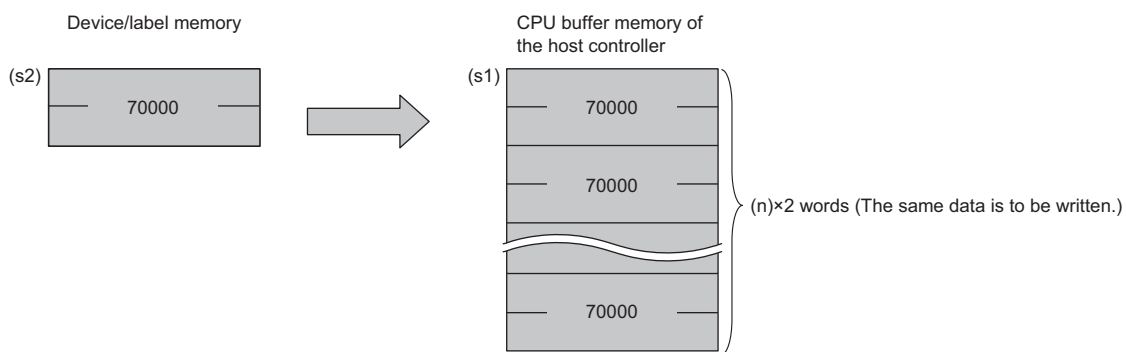
- Writing word data to a host controller



- If a constant is specified in (s2), the instructions write the same data (the value in the device specified by (s2)) to the (n) words from the specified buffer memory address.
- Writing word data to a module



- Writing word data to a host controller

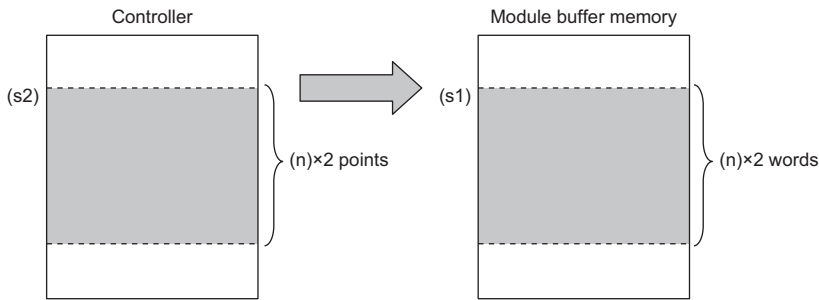


- An instruction which has been executed will result in non-processing if it fails to access the target module because the module is faulty or busy in processing.

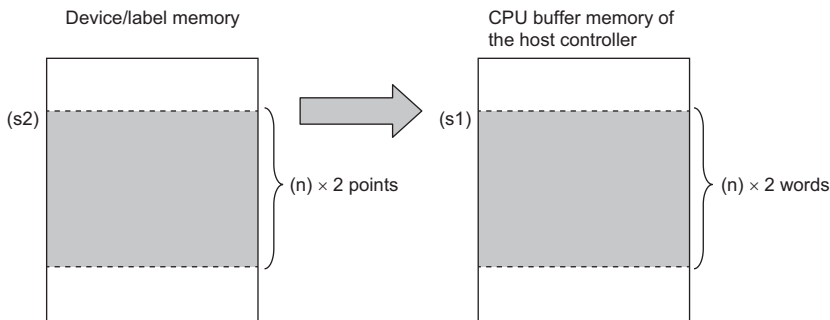


## ■ DTO(P)

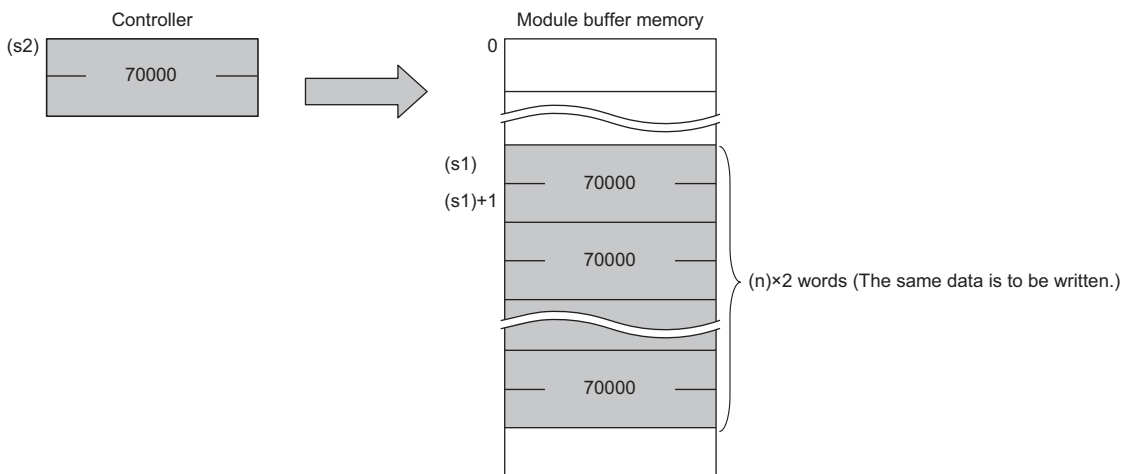
- This instruction writes the  $(n) \times 2$  points of data from the device specified by (s2) to the buffer memory address specified by (s1) and later in the buffer memory in the module or host controller specified by (U/H).
- Writing double word data to a module



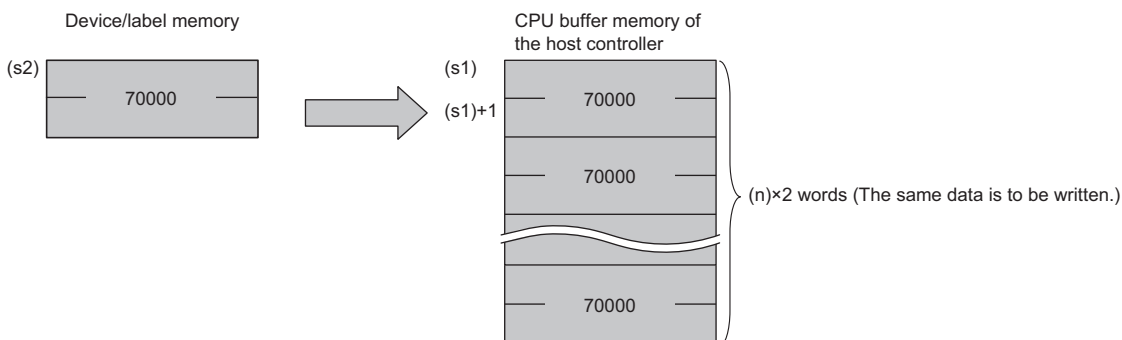
- Writing double word data to a host controller



- If a constant is specified in (s2), the instructions write the same data (the value in the device specified by (s2)) to the  $(n) \times 2$  words from the specified buffer memory address.
- Writing double word data to a module



- Writing double word data to a host controller



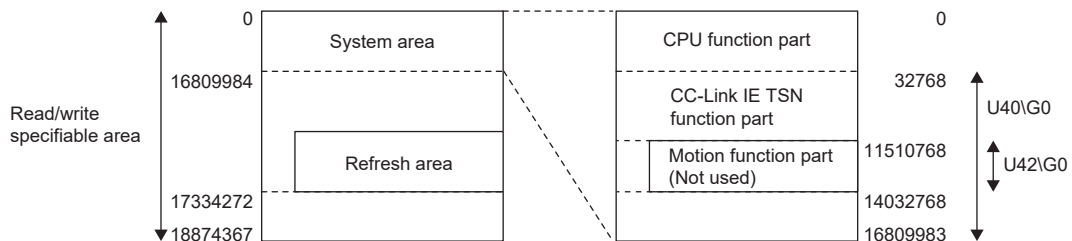
- An instruction which has been executed will result in non-processing if it fails to access the target module because the module is faulty or busy in processing.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | The module with the I/O number specified by (U) does not have buffer memory.                                                                                                                                                                                                                                                                                                                                                |
| 2823H            | The module with the I/O number specified by (H) does not have buffer memory.<br>The address specified by (s1) is outside the range of buffer memory.<br>The (n) points of data starting from the address specified by (s1) are outside the range of buffer memory. (TO(P) instruction)<br>The 2×(n) points of data starting from the address specified by (s1) are outside the range of buffer memory. (DTO(P) instruction) |
| 3602H            | This instruction is executed for the intelligent module in an interrupt program with the priority 1 to 16.                                                                                                                                                                                                                                                                                                                  |

### Point

- If refresh settings are not made for the refresh area of the read/write enabled area in the CPU buffer memory, the area can be used as a read/write specifiable area. Even when refresh settings are made, the area can be used as a read/write specifiable area in the reference send range and later. If the intelligent module number U40\G0 or U42\G0 of the CC-Link IE TSN function part or motion function part is specified in the operand (U/H), the following range can be accessed.



- A CPU buffer memory access device can be used to write data to the CPU buffer memory. (📖 User's manual for the controller used)
- The TO(P) and DTO(P) instructions can write data to the buffer memory address with a capacity of 64K words or less. To write data to the buffer memory address with a capacity exceeding 64K words, use the TOD(P) or DTOD(P) instruction. (📖 Page 1021 TOD(P), DTOD(P))

# Reading 1-word/2-word data from another module (32-bit specification)

## FROMD(P), DFROMD(P)

- FROMD(P):

This instruction reads n words of data from the buffer memory address in the specified module.

- DFROMD(P):

This instruction reads n×2 words of data from the buffer memory address in the specified module.

| Ladder | ST                                                                                                                   |
|--------|----------------------------------------------------------------------------------------------------------------------|
|        | ENO:=FROMD(EN,U/H,s,n,d);<br>ENO:=FROMDP(EN,U/H,s,n,d);<br>ENO:=DFROMD(EN,U/H,s,n,d);<br>ENO:=DFROMDP(EN,U/H,s,n,d); |

| FBD/LD |
|--------|
|        |

## Execution condition

| Instruction       | Execution condition |
|-------------------|---------------------|
| FROMD<br>DFROMD   |                     |
| FROMDP<br>DFROMDP |                     |

## Setting data

### ■Description, range, data type

| Operand | Description                                                                                                       | Range                     | Data type              | Data type (label)   |
|---------|-------------------------------------------------------------------------------------------------------------------|---------------------------|------------------------|---------------------|
| (U/H)   | Intelligent module No.                                                                                            | 1H to 10H, 3E0H, 40H, 42H | 16-bit unsigned binary | ANY16               |
| (s)     | Buffer memory from which the data is read or the start device where the start address of the CPU memory is stored | 0 to 4294967295           | 32-bit unsigned binary | ANY32               |
| (d)     | FROMD(P)                                                                                                          | —                         | 16-bit signed binary   | ANY16 <sup>*1</sup> |
|         | DFROMD(P)                                                                                                         |                           | 32-bit signed binary   | ANY32 <sup>*1</sup> |
| (n)     | Number of read data                                                                                               | 0 to 4294967295           | 32-bit unsigned binary | ANY32               |
| EN      | Execution condition                                                                                               | —                         | Bit                    | BOOL                |
| ENO     | Execution result                                                                                                  | —                         | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word     |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-----------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC     | LZ |                        | K, H     | E | \$ |            |
| (U/H)   | ○                                | ○    | ○                                     | ○           | ○ | —               | —  | ○                      | ○        | — | —  | ○          |
| (s1)    | ○                                | ○    | ○                                     | ○           | ○ | ○               | ○  | ○                      | ○        | — | —  | —          |
| (s2)    | ○                                | —    | ○                                     | —           | — | ○ <sup>*1</sup> | —  | ○                      | ○        | — | —  | —          |
| (n)     | ○                                | ○    | ○                                     | ○           | ○ | ○               | ○  | ○                      | ○        | — | —  | —          |

\*1 Only the DFROMD(P) instruction can be used.

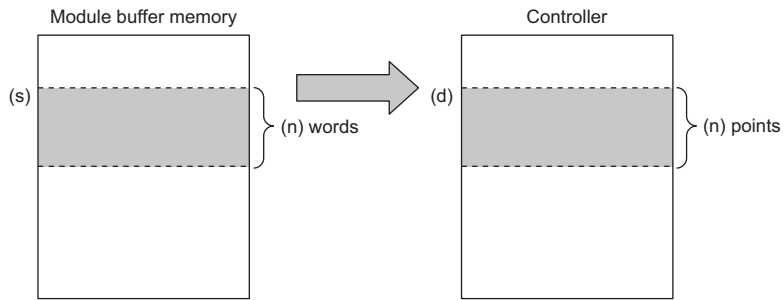
## Processing details

Specify the intelligent module numbers of the controller as shown in the table below.

| Controller                     | Intelligent module No. |
|--------------------------------|------------------------|
| CPU function part              | 3E0H                   |
| Built-in network function part | 40H                    |
| Built-in motion function part  | 42H                    |

### ■FROMD(P)

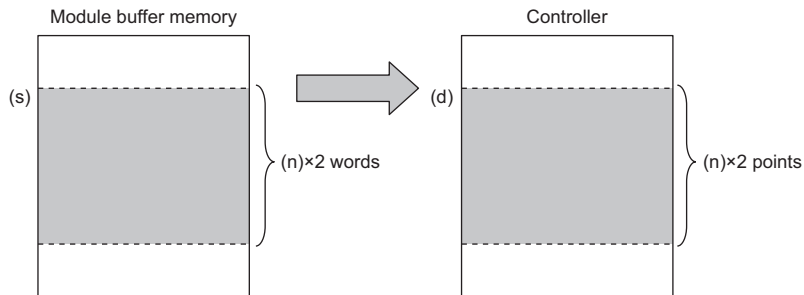
- This instruction reads (n) words of data from the buffer memory address specified by (s) in the module specified by (U/H), and stores in the device specified by (d) and later.



- If the read data (n) is 0, no processing is performed.
- An instruction which has been executed will result in non-processing if it fails to access the target module because the module is faulty or busy in processing.

### ■DFROMD(P)

- This instruction reads (n)×2 words of data from the buffer memory address specified by (s) in the module specified by (U/H), and stores in the device specified by (d) and later.



- If the read data (n) is 0, no processing is performed.
- An instruction which has been executed will result in non-processing if it fails to access the target module because the module is faulty or busy in processing.

## Operation error

| Error code (SD0) | Description                                                                                                                             |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | The module with the I/O number specified by (U) does not have buffer memory.                                                            |
|                  | The address specified by (s) is outside the range of CPU buffer memory.                                                                 |
|                  | The (n) points of data starting from the address specified by (s) are outside the range of CPU buffer memory. (FROMD(P) instruction)    |
|                  | The 2×(n) points of data starting from the address specified by (s) are outside the range of CPU buffer memory. (DFROMD(P) instruction) |
| 2823H            | The module with the I/O number specified by (H) does not have buffer memory.                                                            |
|                  | The address specified by (s) is outside the range of buffer memory.                                                                     |
|                  | The (n) points of data starting from the address specified by (s) are outside the range of buffer memory. (FROMD(P) instruction)        |
|                  | The 2×(n) points of data starting from the address specified by (s) are outside the range of buffer memory. (DFROMD(P) instruction)     |
| 3602H            | This instruction is executed for the intelligent module in an interrupt program with the priority 1 to 16.                              |

### Point

- If refresh settings are not made for the refresh area of the read/write enabled area in the CPU buffer memory, the area can be used as a read/write specifiable area. Even when refresh settings are made, the area can be used as a read/write specifiable area in the reference send range and later.
- A CPU buffer memory access device can be used to read data from the CPU buffer memory. ( User's manual for the controller used)
- The FROMD(P) and DFROMD(P) instructions can read data from the buffer memory address with a capacity exceeding 64K.

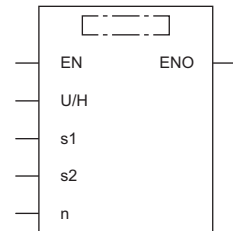
## Writing 1-word/2-word data to a module (32-bit specification)

### TOD(P), DTOD(P)

- TOD(P): This instruction writes the n points of data from the specified device to the buffer memory in the module.
- DTOD(P): This instruction writes the n×2 points of data from the specified device to the buffer memory in the module.

| Ladder | ST                                                                                                                       |
|--------|--------------------------------------------------------------------------------------------------------------------------|
|        | <pre> ENO:=TOD(EN,U/H,s1,s2,n); ENO:=TODP(EN,U/H,s1,s2,n); ENO:=DTOD(EN,U/H,s1,s2,n); ENO:=DTODP(EN,U/H,s1,s2,n); </pre> |

### FBD/LD



### Execution condition

| Instruction   | Execution condition |
|---------------|---------------------|
| TOD<br>DTOD   |                     |
| TODP<br>DTODP |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                                                                    | Range                     | Data type              | Data type (label)   |
|---------|----------------------------------------------------------------------------------------------------------------|---------------------------|------------------------|---------------------|
| (U/H)   | Intelligent module No.                                                                                         | 1H to 10H, 3E0H, 40H, 42H | 16-bit unsigned binary | ANY16               |
| (s1)    | Buffer memory to which the data is written or the start device where the start address of CPU memory is stored | 0 to 4294967295           | 32-bit unsigned binary | ANY32               |
| (s2)    | Write data or the start device where the write data is stored                                                  | -32768 to 32767           | 16-bit signed binary   | ANY16 <sup>*1</sup> |
|         |                                                                                                                | -2147483648 to 2147483647 | 32-bit signed binary   | ANY32 <sup>*1</sup> |
| (n)     | Number of write data                                                                                           | 0 to 4294967295           | 32-bit unsigned binary | ANY32               |
| EN      | Execution condition                                                                                            | —                         | Bit                    | BOOL                |
| ENO     | Execution result                                                                                               | —                         | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

| Operand | Bit                              |     | Word                                  |             |   | Double word     |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|-----|---------------------------------------|-------------|---|-----------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC     | LZ |                        | K, H     | E | \$ |            |
| (U/H)   | ○                                | ○   | ○                                     | ○           | ○ | —               | —  | ○                      | ○        | — | —  | ○          |
| (s1)    | ○                                | ○   | ○                                     | ○           | ○ | ○               | ○  | ○                      | ○        | — | —  | —          |
| (s2)    | ○                                | —   | ○                                     | —           | — | ○ <sup>*1</sup> | —  | ○                      | ○        | — | —  | —          |
| (n)     | ○                                | ○   | ○                                     | ○           | ○ | ○               | ○  | ○                      | ○        | — | —  | —          |

\*1 Only the DTOD(P) instruction can be used.

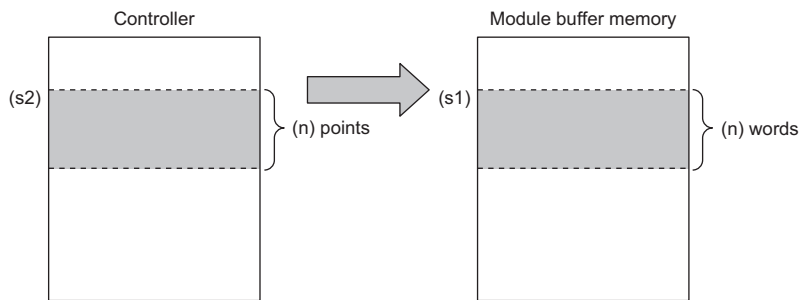
## Processing details

Specify the intelligent module numbers of the controller as shown in the table below.

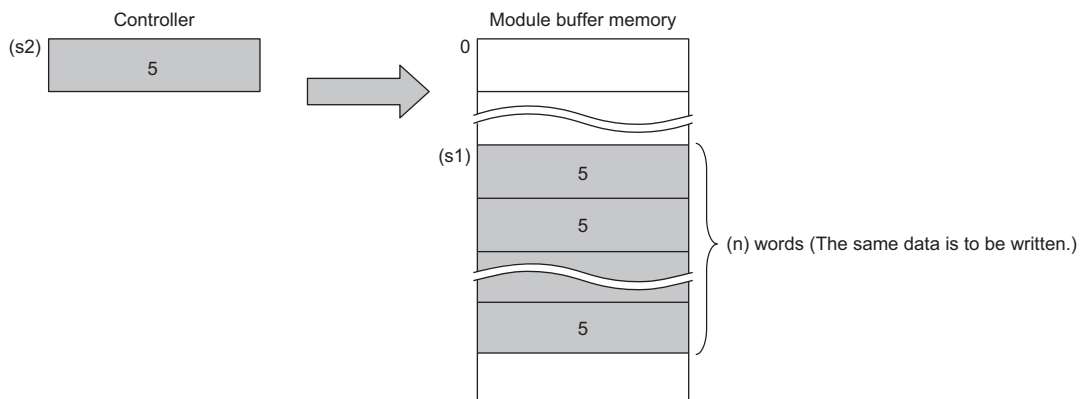
| Controller                     | Intelligent module No. |
|--------------------------------|------------------------|
| CPU function part              | 3E0H                   |
| Built-in network function part | 40H                    |
| Built-in motion function part  | 42H                    |

### ■TOD(P)

- This instruction writes the *n* points of data from the device specified by (s2) to the buffer memory address specified by (s1) and later in the buffer memory in the module or host controller specified by (U/H).



- If a constant is specified in (s2), the instructions write the same data (the value in the device specified by (s2)) to the (n) words from the specified buffer memory address.

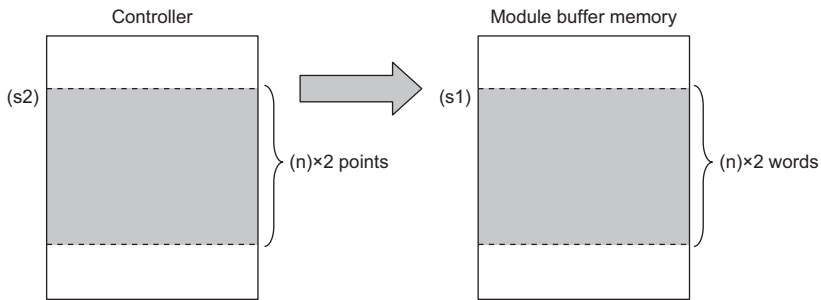


- An instruction which has been executed will result in non-processing if it fails to access the target module because the module is faulty or busy in processing.

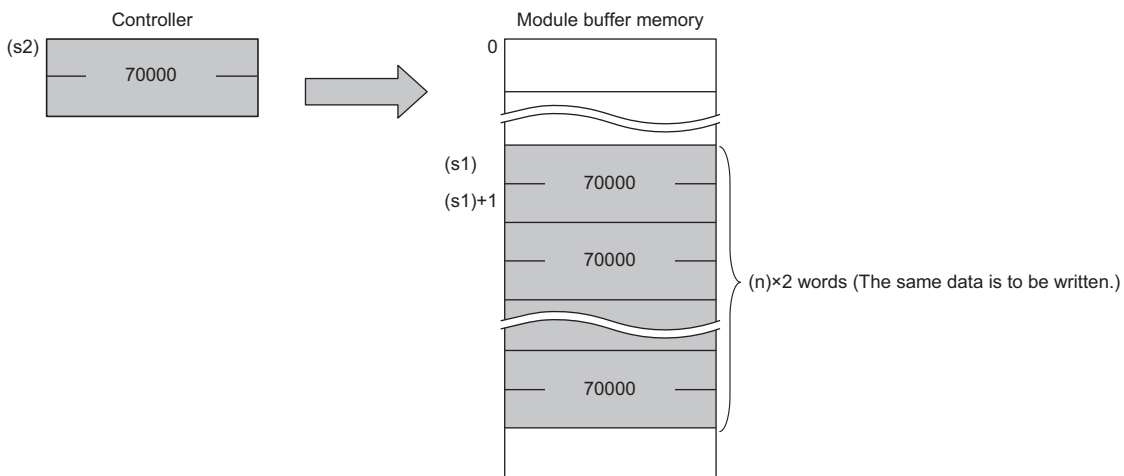


## ■DTOD(P)

- This instruction writes the  $(n) \times 2$  points of data from the device specified by (s2) to the buffer memory address specified by (s1) and later in the buffer memory in the module or host controller specified by (U/H).



- If a constant is specified in (s2), the instructions write the same data (the value in the device specified by (s2)) to the  $(n) \times 2$  words from the specified buffer memory address.



- An instruction which has been executed will result in non-processing if it fails to access the target module because the module is faulty or busy in processing.

## Operation error

| Error code (SD0) | Description                                                                                                                                     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | The module with the I/O number specified by (U) does not have buffer memory.                                                                    |
|                  | The address specified by (s1) is outside the range of CPU buffer memory.                                                                        |
|                  | The (n) points of data starting from the address specified by (s1) are outside the range of CPU buffer memory. (TOD(P) instruction)             |
|                  | The $2 \times (n)$ points of data starting from the address specified by (s1) are outside the range of CPU buffer memory. (DTOD(P) instruction) |
| 2823H            | The module with the I/O number specified by (H) does not have buffer memory.                                                                    |
|                  | The address specified by (s1) is outside the range of buffer memory.                                                                            |
|                  | The (n) points of data starting from the address specified by (s1) are outside the range of buffer memory. (TOD(P) instruction)                 |
|                  | The $2 \times (n)$ points of data starting from the address specified by (s1) are outside the range of buffer memory. (DTOD(P) instruction)     |
| 3602H            | This instruction is executed for the intelligent module in an interrupt program with the priority 1 to 16.                                      |

### Point

- If refresh settings are not made for the refresh area of the read/write enabled area in the CPU buffer memory, the area can be used as a read/write specifiable area. Even when refresh settings are made, the area can be used as a read/write specifiable area in the reference send range and later.
- A CPU buffer memory access device can be used to write data to the CPU buffer memory. ( User's manual for the controller used)
- The TOD(P) and DTOD(P) instructions can write data to the buffer memory address with a capacity exceeding 64K.

# Reading module specific information

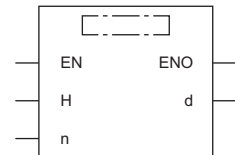
22

## UNIINFRD(P)

This instruction reads information of all mounted modules.

| Ladder | ST                                                            |
|--------|---------------------------------------------------------------|
|        | <pre>ENO:=UNIINFRD(EN,H,n,d); ENO:=UNIINFRDP(EN,H,n,d);</pre> |

## FBD/LD



## Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| UNIINFRD    |                     |
| UNIINFRDP   |                     |

## Setting data

### Description, range, data type

| Operand | Description                                                                   | Range      | Data type              | Data type (label)   |
|---------|-------------------------------------------------------------------------------|------------|------------------------|---------------------|
| (H)     | Dummy                                                                         | —          | 16-bit unsigned binary | ANY16               |
| (d)     | Start device for storing module information<br>(Secure an area for 56 words.) | —          | Word                   | ANY16 <sup>*1</sup> |
| (n)     | Dummy                                                                         | 28 (fixed) | 16-bit unsigned binary | ANY16               |
| EN      | Execution condition                                                           | —          | Bit                    | BOOL                |
| ENO     | Execution result                                                              | —          | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (H)     | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

This instruction stores the module information in the device areas specified by (d) and later.  
The data structure is shown below.

| Device           | Area    | Description                                       |
|------------------|---------|---------------------------------------------------|
| (d)<br>(d)+1     | Area 0  | Information of the CPU function part              |
| (d)+2<br>(d)+3   | Area 1  | Information of the built-in network function part |
| (d)+4<br>(d)+5   | Area 2  | Information of the built-in motion function part  |
| (d)+6<br>(d)+7   | Area 3  | Information of the built-in I/O function part     |
| (d)+8<br>(d)+9   | Area 4  | Information of the extension module               |
| ⋮                | ⋮       |                                                   |
| (d)+42<br>(d)+43 | Area 21 |                                                   |
| (d)+44<br>(d)+45 | Area 22 | Information of the expansion adapter              |
| ⋮                | ⋮       |                                                   |
| (d)+54<br>(d)+55 | Area 27 |                                                   |

- The following shows detailed module information.

|       |     |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    |
|-------|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
|       | b15 | b14 | b13 | b12 | b11 | b10 | b9 | b8 | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
| (d)   |     |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    |
| (d)+1 |     |     |     |     |     |     |    |    |    |    |    |    |    |    |    |    |

| Device | Bit | Item name                                                                 | Description                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------|-----|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (d)    | b0  | Number of input points                                                    | 000: 0 points                                                                                                                                                                                                                                                                                                                                                                                                                 |
|        | b1  |                                                                           | 001: 8 points                                                                                                                                                                                                                                                                                                                                                                                                                 |
|        | b2  |                                                                           | 010: 16 points                                                                                                                                                                                                                                                                                                                                                                                                                |
|        | b3  |                                                                           | 011: 24 points                                                                                                                                                                                                                                                                                                                                                                                                                |
|        | b4  | Number of output points                                                   | 100: 32 points                                                                                                                                                                                                                                                                                                                                                                                                                |
|        | b5  |                                                                           | 101: 40 points                                                                                                                                                                                                                                                                                                                                                                                                                |
|        | b6  |                                                                           | 110: 48 points                                                                                                                                                                                                                                                                                                                                                                                                                |
|        | b7  |                                                                           | 111: 64 points                                                                                                                                                                                                                                                                                                                                                                                                                |
|        | b8  | Module type                                                               | 0000: Type recognition error                                                                                                                                                                                                                                                                                                                                                                                                  |
|        | b9  |                                                                           | 0001: Input                                                                                                                                                                                                                                                                                                                                                                                                                   |
|        | b10 |                                                                           | 0010: Output                                                                                                                                                                                                                                                                                                                                                                                                                  |
|        | b11 |                                                                           | 0100: High-speed I/O                                                                                                                                                                                                                                                                                                                                                                                                          |
|        | b12 | Series type                                                               | 0101: Extension power supply                                                                                                                                                                                                                                                                                                                                                                                                  |
|        | b13 | Error*1                                                                   | 0110: Adapter (serial)                                                                                                                                                                                                                                                                                                                                                                                                        |
|        | b14 |                                                                           | 0111: Adapter (analog)                                                                                                                                                                                                                                                                                                                                                                                                        |
| (d)+1  | b15 | Module ready                                                              | 1000: Intelligent or CPU built-in function                                                                                                                                                                                                                                                                                                                                                                                    |
|        | b0  | Start XY, Intelligent Module No., Serial Communication ch, Analog ADP No. | 00: Unknown                                                                                                                                                                                                                                                                                                                                                                                                                   |
|        | b1  |                                                                           | 01: MX-F                                                                                                                                                                                                                                                                                                                                                                                                                      |
|        | b2  |                                                                           | 0: Module not mounted                                                                                                                                                                                                                                                                                                                                                                                                         |
|        | b3  |                                                                           | 1: Module mounted                                                                                                                                                                                                                                                                                                                                                                                                             |
|        | b4  |                                                                           | 00: Normal                                                                                                                                                                                                                                                                                                                                                                                                                    |
|        | b5  |                                                                           | 01: Minor error                                                                                                                                                                                                                                                                                                                                                                                                               |
|        | b6  |                                                                           | 10: Medium error                                                                                                                                                                                                                                                                                                                                                                                                              |
|        | b7  |                                                                           | 11: Major error                                                                                                                                                                                                                                                                                                                                                                                                               |
|        | b8  |                                                                           | 0: Not ready                                                                                                                                                                                                                                                                                                                                                                                                                  |
|        | b9  |                                                                           | 1: Ready                                                                                                                                                                                                                                                                                                                                                                                                                      |
|        | b10 |                                                                           | <ul style="list-style-type: none"> <li>• When the module type is input/output/high-speed I/O: Value calculated by dividing the start XY by 16</li> <li>• When the module type is an intelligent function module: Intelligent Module No.</li> <li>• When the module type is an expansion adapter (serial): Serial Communication ch</li> <li>• When the module type is an expansion adapter (analog): Analog ADP No.</li> </ul> |
|        | b11 |                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                               |
|        | b12 |                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                               |
|        | b13 |                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                               |
|        | b14 |                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                               |
|        | b15 |                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                               |

\*1 For expansion adapters, "00: Normal" is always stored as there is no module-specific error status.

- The following table lists the module information of the CPU function part, built-in network function part, built-in motion function part, and built-in I/O function part inside the controller.

| Device | Bit       | Item name                                                                 | CPU function part (area 0)                     | Built-in network function part (area 1) | Built-in motion function part (area 2) | Built-in I/O function part (area 3)                        |
|--------|-----------|---------------------------------------------------------------------------|------------------------------------------------|-----------------------------------------|----------------------------------------|------------------------------------------------------------|
| (d)    | b0        | Number of input points                                                    | 000<br>(0 points)                              | 000<br>(0 points)                       | 000<br>(0 points)                      | 010<br>(16 points)                                         |
|        | b1        |                                                                           |                                                |                                         |                                        |                                                            |
|        | b2        |                                                                           |                                                |                                         |                                        |                                                            |
|        | b3        | Number of output points                                                   | 000<br>(0 points)                              | 000<br>(0 points)                       | 000<br>(0 points)                      | 010<br>(16 points)                                         |
|        | b4        |                                                                           |                                                |                                         |                                        |                                                            |
|        | b5        |                                                                           |                                                |                                         |                                        |                                                            |
|        | b6        | Module type                                                               | 1000<br>(Intelligent or CPU built-in function) | 0000                                    | 0000                                   | 0011                                                       |
|        | b7        |                                                                           |                                                |                                         |                                        |                                                            |
|        | b8        |                                                                           |                                                |                                         |                                        |                                                            |
|        | b9        |                                                                           |                                                |                                         |                                        |                                                            |
|        | b10       | Series type                                                               | 01<br>(MX-F)                                   | 00                                      | 00                                     | 01<br>(MX-F)                                               |
|        | b11       |                                                                           |                                                |                                         |                                        |                                                            |
|        | b12       | Module mounted                                                            | 1                                              | 1                                       | 1                                      | 1                                                          |
|        | b13       | Error                                                                     | (Varies depending on the content.)             | 00                                      | 00                                     | 00                                                         |
|        | b14       |                                                                           |                                                |                                         |                                        |                                                            |
|        | b15       | Module ready                                                              | 1                                              | 0                                       | 0                                      | 1                                                          |
| (d)+1  | b15 to b0 | Start XY, Intelligent Module No., Serial Communication ch, Analog ADP No. | 03E0H<br>(Intelligent Module No.)              | 0040H<br>(Intelligent Module No.)       | 0042H<br>(Intelligent Module No.)      | 0000H<br>(Value calculated by dividing the start XY by 16) |

## Operation error

| Error code (SD0) | Description                                                                                                                                       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | The range specified by (d) exceeds the corresponding device/label.                                                                                |
| 3602H            | This instruction was executed in an interrupt program with the priority 1 to 16 in a configuration that includes at least one intelligent module. |
| 36C5H            | Timeout occurred while communicating with modules during execution of the instruction.                                                            |
| 36C7H            | Signal error was detected while accessing modules during execution of the instruction.                                                            |

# 23 PID OPERATION INSTRUCTION

## PID operation instruction and PID control instruction

There are two types of instructions for PID control.

| Type                      | Application                                                                                               | Reference (Overview) | Reference (Details)                                                                                                |
|---------------------------|-----------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------|
| PID operation instruction | This instruction is used to perform PID control using auto tuning.                                        | Page 1029 Overview   | Page 1041 PID Operation Instruction                                                                                |
| PID control instruction   | This instruction is used to perform PID control equal to that of the MELSEC-Q series and MELSEC-L series. | Page 1045 Overview   | Page 1054 PID Control Instructions (Inexact Differential), Page 1066 PID Control Instructions (Exact Differential) |

The following table lists the specifications comparison between PID operation instruction and PID control instruction.

| Item                          | PID operation instruction                             | PID control instruction                 |
|-------------------------------|-------------------------------------------------------|-----------------------------------------|
| PID operation method          | Inexact differential                                  | Inexact differential/exact differential |
| Sampling period/sampling time | 1 to 32767ms                                          | 10 to 60000ms                           |
| Number of control loops       | 1 loop per instruction                                | 32 loops maximum                        |
| Auto tuning                   | Enabled (limit cycle method and step response method) | Disabled                                |

## 23.1 Overview

This section describes an overview of PID control using the PID operation instruction.

### PID operation instruction

The PID operation instruction calculates the manipulated value (MV) from the process value (PV) by combining the P action (proportional action), I action (integral action), and D action (derivative action) to get closer to the set value (SV).

#### ■Alarm output function

This function turns on the alarm output for the variations of input (process value) and output (manipulated value).

#### ■Output upper/lower limit value setting

This function suppresses the increase of integral terms in PID control by setting the output upper/lower limit values.

#### ■Auto tuning function

This function automatically sets the proportional gain ( $K_P$ ), integral time ( $T_I$ ), and derivative time ( $T_D$ ). The auto tuning is performed in two methods: limit cycle method and step response method.

#### ■Operation method of the PID operation instruction

The instruction performs PID operation in the velocity type or the process value derivative type.

## Basic operational expressions of PID operation instruction [Reference]

The instruction performs PID operation in the velocity type or the process value derivative type.

An operational expression of direct action or reverse action is executed depending on the value of bit 0 in the device specified by (s3)+1 (Action setting (ACT)).

The operation is performed using the control data stored in the device areas, (s3) and later.

- Operational expressions

| Action<br>(Bit 0 of (s3)+1) | Operational expression                                                                                                                                                                                                                                       |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Direct action<br>(Off)      | $\Delta MV = K_p \{ (EV_n - EV_{n-1}) + \frac{T_S}{T_I} EV_n + D_n \}$ $EV_n = PV_{nf} - SV$ $D_n = \frac{T_D}{T_S + K_D \cdot T_D} (-2PV_{nf-1} + PV_{nf} + PV_{nf-2}) + \frac{K_D \cdot T_D}{T_S + K_D \cdot T_D} \cdot D_{n-1}$ $MV_n = \Sigma \Delta MV$ |
| Reverse action<br>(On)      | $\Delta MV = K_p \{ (EV_n - EV_{n-1}) + \frac{T_S}{T_I} EV_n + D_n \}$ $EV_n = SV - PV_{nf}$ $D_n = \frac{T_D}{T_S + K_D \cdot T_D} (2PV_{nf-1} - PV_{nf} - PV_{nf-2}) + \frac{K_D \cdot T_D}{T_S + K_D \cdot T_D} \cdot D_{n-1}$ $MV_n = \Sigma \Delta MV$  |

The meaning of the symbols in the operational expressions is as follows.

| Symbol      | Meaning                                                                 |
|-------------|-------------------------------------------------------------------------|
| $EV_n$      | Deviation in the sampling period this time                              |
| $EV_{n-1}$  | Deviation in the sampling period last time                              |
| $SV$        | Set value                                                               |
| $PV_{nf}$   | Process value of the sampling period this time (after filtering)        |
| $PV_{nf-1}$ | Process value of the sampling period last time (after filtering)        |
| $PV_{nf-2}$ | Process value of the sampling period two times before (after filtering) |
| $\Delta MV$ | Output variation amount                                                 |
| $MV_n$      | Manipulated value this time                                             |
| $D_n$       | Derivative term this time                                               |
| $D_{n-1}$   | Derivative term of the sampling period last time                        |
| $K_p$       | Proportional gain                                                       |
| $T_S$       | Sampling period                                                         |
| $T_I$       | Integral constant                                                       |
| $T_D$       | Derivative constant                                                     |
| $K_D$       | Derivative gain                                                         |

$PV_{nf}$  (process value of the sampling period this time (after filtering)) is calculated by using the following operational expression. If the input filter coefficient is not set, the value will be the same as the input process value (PV).

$$PV_{nf} = PV_n + L(PV_{nf-1} - PV_n)$$

Where,  $PV_{nf}$ : Process value for the sampling period this time, L: Filter coefficient,  $PV_{nf-1}$ : Process value for the sampling period last time (after filtering)



## Control data

The details on the control data used by the PID operation instruction are described.

### Sampling time: (s3)

Setting range: 1 to 32767 [ms]

Set a cycle (ms) to perform PID operation.

- Auto tuning (limit cycle method)

Set a cycle so that the following condition is satisfied: Operation cycle of the programmable controller < Sampling time

- Auto tuning (step response method)

Set a cycle to 1000ms or longer.

### ■Maximum error

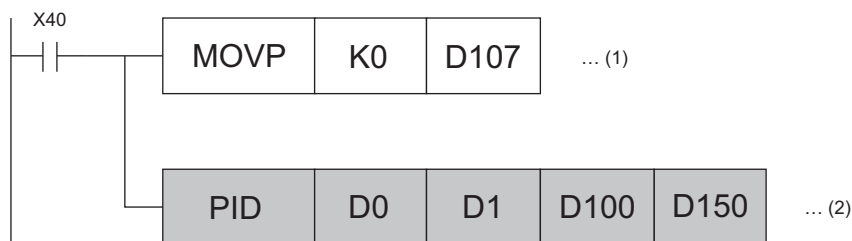
The maximum error of the sampling time ( $T_S$ ) is  $-(1 \text{ operation cycle} + 1\text{ms})$  to  $+(1 \text{ operation cycle})$ .

- When the sampling time ( $T_S$ ) value is small

The variation in the maximum error may become a problem. Set the constant scan and execute the instruction, or program it in the timer interrupt routine.

- When the sampling time value is shorter than one operation cycle of the programmable controller

A PID operation error (11A6H) occurs, but PID operation is executed assuming that the sampling time ( $T_S$ ) equals to the operation cycle. In this case, program the instruction in the timer interrupt routine, clear the value in (s3)+7, and then execute the instruction.



(1) Reset the value in (s3)+7. (The internal processing register is cleared by the pulse conversion command at the first execution of the interrupt routine.)

(2) Execute the PID operation.

## Action setting: (s3)+1

### ■Direction (direct action/reverse action): Bit 0 of (s3)+1

Setting range: Off = Direct action, On = Reverse action

Select the direction of PID control, direction action or reverse action.

- Auto tuning (limit cycle method)

The PID control direction must be set.

- Auto tuning (step response method)

At completion of auto tuning executed in whichever mode, direct action or reverse action, setting is made automatically.

[Direct action (bit 0 of (s3)+1 = Off)]

[Reverse action (bit 0 of (s3)+1 = On)]

### ■Alarm setting (input variation, output variation): Bit 1 and bit 2 of (s3)+1

Setting range: Off = Alarm disabled, On = Alarm enabled

The input and output variation amounts can be checked. The check result can be checked in (s3)+24. (Page 1038 Alarm output flag: (s3)+24)

- Input variation (bit 1 of (s3)+1)

To use the input variation alarm, the following bit needs to be on and the values need to be set to the following devices.

| Setting item                        |         |       | Description                                    | Setting range                |
|-------------------------------------|---------|-------|------------------------------------------------|------------------------------|
| Action setting (ACT)                | (s3)+1  | Bit 1 | Input variation alarm                          | On: Enabled<br>Off: Disabled |
| Input variation alarm setting value | (s3)+20 |       | Input variation (increase) alarm setting value | 0 to 32767                   |
|                                     | (s3)+21 |       | Input variation (decrease) alarm setting value |                              |

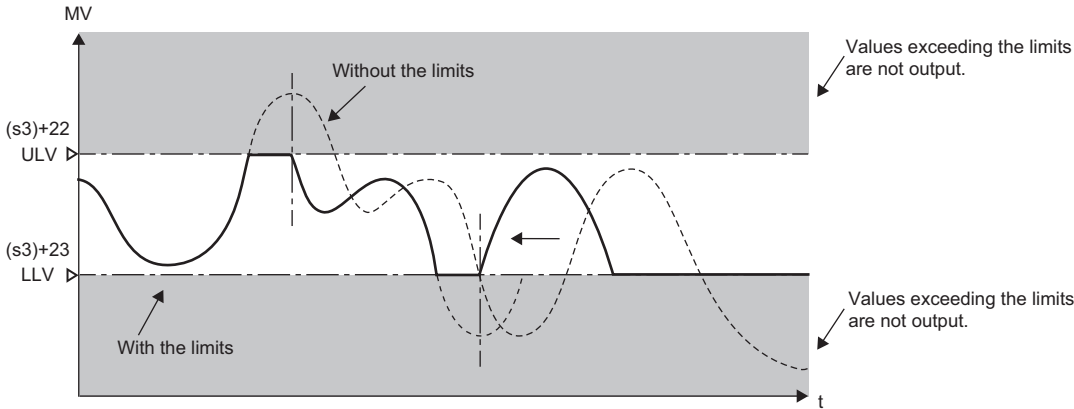
- Output variation (bit 2 of (s3)+1)

To use the output variation alarm, the following bits need to be on and the values need to be set to the following devices.

| Setting item                         |         |       | Description                                     | Setting range                |
|--------------------------------------|---------|-------|-------------------------------------------------|------------------------------|
| Action setting (ACT)                 | (s3)+1  | Bit 2 | Output variation alarm                          | On: Enabled<br>Off: Disabled |
|                                      |         | Bit 5 | Output upper/lower limit value setting          | Off (always)                 |
| Output variation alarm setting value | (s3)+22 |       | Output variation (increase) alarm setting value | 0 to 32767                   |
|                                      | (s3)+23 |       | Output variation (decrease) alarm setting value |                              |

■Output upper/lower limit value setting: Bit 5 of (s3)+1

The manipulated value (MV) will be as follows according to this setting.



MV: Manipulated value  
ULV: Output upper limit value  
LLV: Output lower limit value  
t: Time

This setting suppresses the increase of integral terms in PID control. To use this function, turn off the bit 2 of (s3)+1.

| Setting item         |        |       | Description                            | Setting range                |
|----------------------|--------|-------|----------------------------------------|------------------------------|
| Action setting (ACT) | (s3)+1 | Bit 2 | Output variation alarm                 | Off (always)                 |
|                      |        | Bit 5 | Output upper/lower limit value setting | On: Enabled<br>Off: Disabled |

## Input filter: (s3)+2

Setting range: 0 to 99 [%]

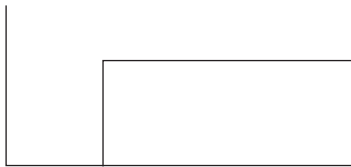
PID control: Proportional action, integral action, derivative action

The input filter ( $\alpha$ ) is a software filter used to reduce the variations caused by noise in the process value (PV). The influence of noise can be suppressed by setting the input filter ( $\alpha$ ) properly according to the characteristics and noise level of the control target.

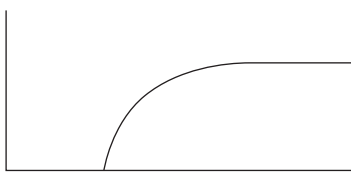
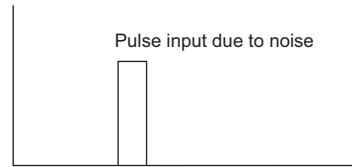
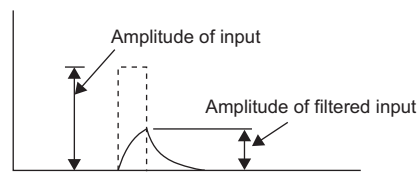
- If the filter coefficient is too small, the effect will be reduced.
- If the filter coefficient is too large, the input response will deteriorate.

The input filter ( $\alpha$ ) acts on the set value (SV) and thus affects the proportional action, integral action, and derivative action.

Actual process  
value (PV)



Filtered process  
value (PV)



## Proportional gain: (s3)+3

Setting range: 1 to 32767 [%]

PID control: Proportional action

The manipulated value (MV) increases in proportion to the deviation (difference between the set value (SV) and the process value (PV)) in proportional operation. This ratio is called the proportional gain ( $K_P$ ) and represented by the following relational expression.

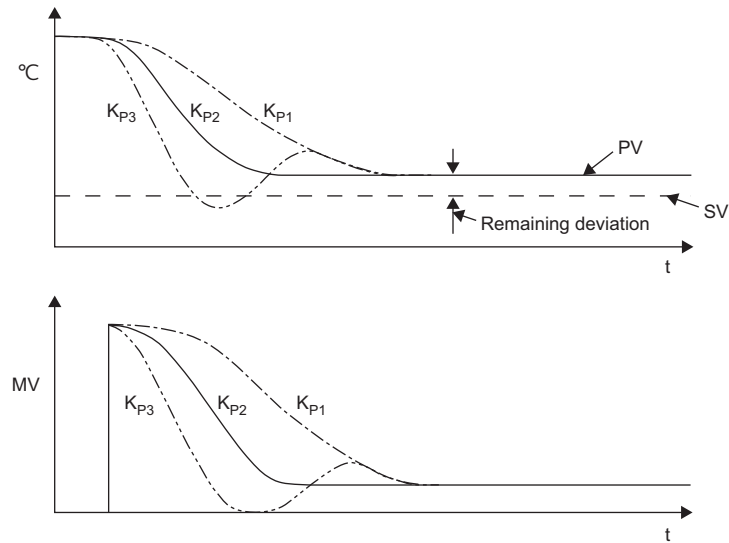
Manipulated value (MV) = Proportional gain ( $K_P$ ) × Deviation (EV)

The reciprocal of the proportional gain ( $K_P$ ) is called the proportional band.

As the proportional gain ( $K_P$ ) increases, the motion to get the process value (PV) closer to the set value (SV) becomes strong.

**Ex.**

Proportional action (P action) in the case of cooling (direct action)



Proportional gain ( $K_P$ ):  $K_{P3} > K_{P2} > K_{P1}$

°C: Temperature

SV: Set value

PV: Process value

MV: Manipulated value

t: Time

## Integral time: (s3)+4

Setting range: 0 to 32767 [ $\times 100\text{ms}$ ] ( $0 = \infty$ ) (No integration)

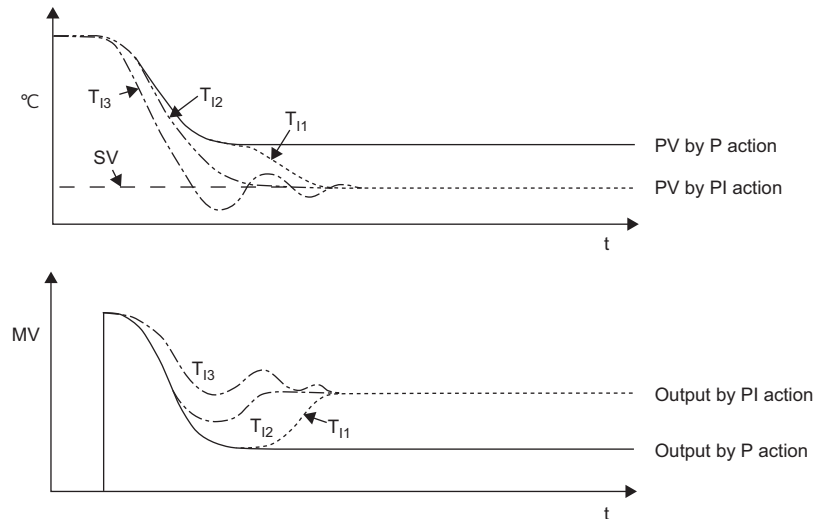
PID control: Integral action

The integral time ( $T_I$ ) is the time from when a deviation occurs in integral action to when the output of the integral action becomes the output of proportional action.

Reducing the integral time ( $T_I$ ) accelerates the integral operation.

**Ex.**

PI action in the case of cooling (direct action)



Integral time ( $T_I$ ):  $0 < T_{I3} < T_{I2} < T_{I1}$

°C: Temperature

SV: Set value

MV: Manipulated value

t: Time

## Derivative gain: (s3)+5

Setting range: 0 to 200 [%]

PID control: Derivative action

The output of the derivative action is filtered. The derivative gain ( $K_D$ ) affects only the derivative action.

- If the derivative gain ( $K_D$ ) is decreased, the output responds instantaneously to a change in the process value (PV) caused by a disturbance.
- If the derivative gain ( $K_D$ ) is increased, the output takes time to respond to a change in the process value (PV) caused by a disturbance.

**Point**

First, set the derivative gain ( $K_D$ ) to 0 and adjust it using the input filter ( $\alpha$ ). If the change in the output responds too sensitive to the disturbance, increase the value.

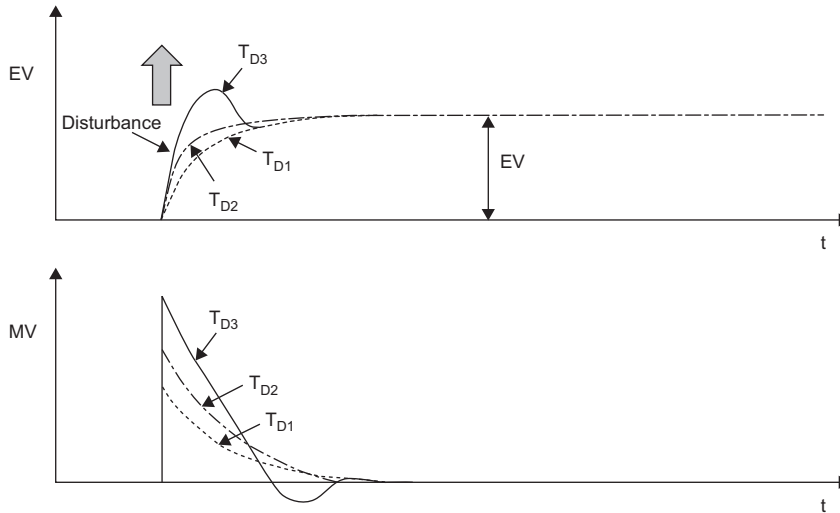
## Derivative time ( $T_D$ ): (s3)+6

Setting range: 0 to 32767 [ $\times 10\text{ms}$ ] (0 = no derivation)

PID control: Derivative action

The derivative time is used to be sensitive to the change in the process value (PV) caused by a disturbance and minimize the changes.

- Increasing the derivative time ( $T_D$ ) prevents more positively the control target from fluctuating due to a disturbance.



Derivative time ( $T_D$ ):  $T_{D3} > T_{D2} > T_{D1}$

EV: Deviation

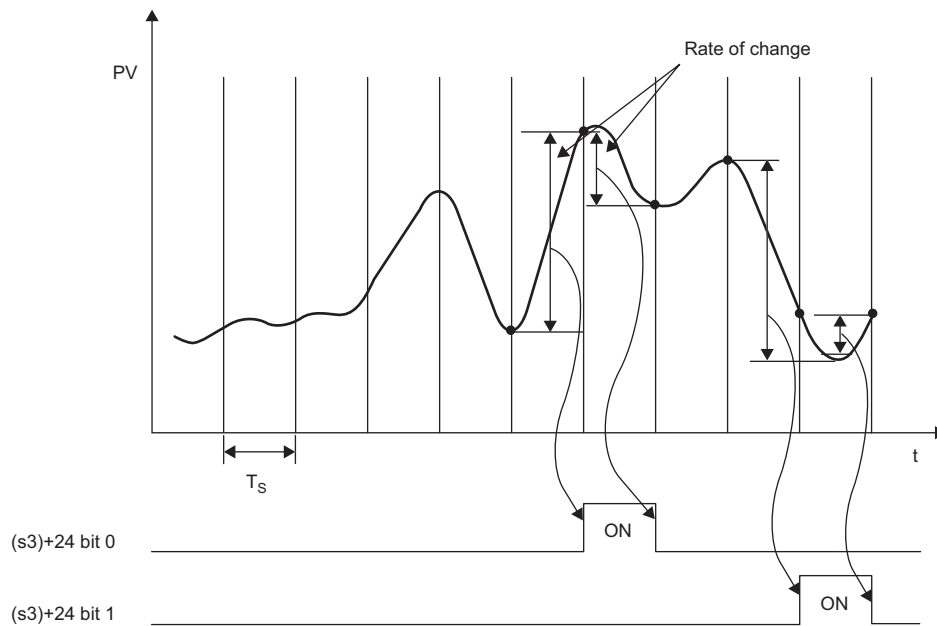
MV: Manipulated value

t: Time

## Alarm output flag: (s3)+24

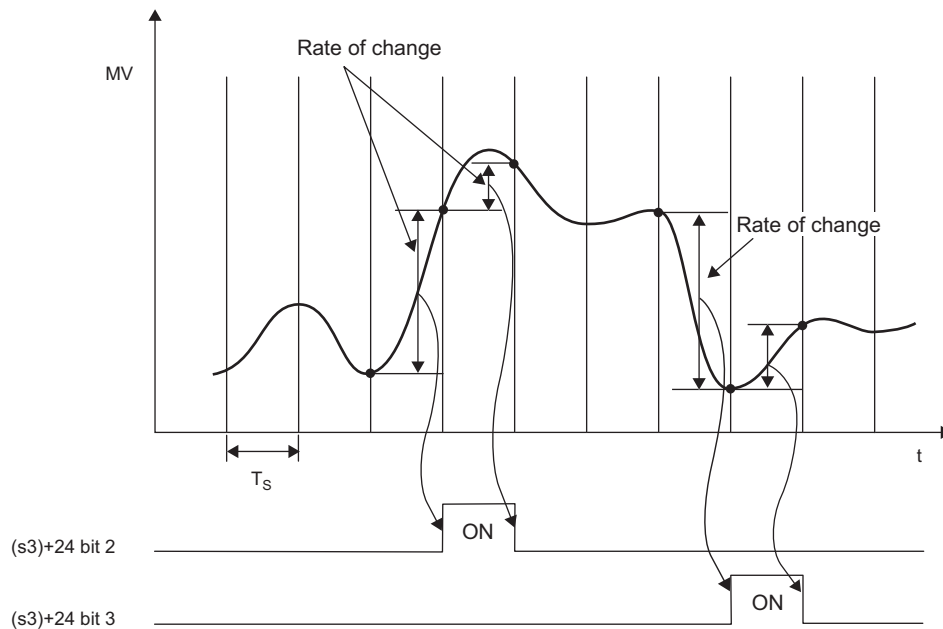
When the set input/output variation is exceeded, bits of (s3)+24 turn on as an alarm flag immediately after execution of the PID operation instruction.

- When the input variation alarm (bit 1 of (s3)+1) is on



PV: Process value  
 $T_s$ : Sampling time  
 t: Time  
 Bit 0 and bit 1 of (s3)+24: Alarm flag

- When the output variation alarm (bit 2 of (s3)+1) is on



MV: Manipulated value  
 $T_s$ : Sampling time  
 t: Time  
 Bit 2 and bit 3 of (s3)+24: Alarm flag



## Auto tuning

To obtain satisfactory results in PID control, it is required to determine the optimum values of each constant (control data) appropriate for the control target. The auto tuning function automatically sets the important constants for PID control, proportional gain, integral time, and derivative time.

The auto tuning function is performed in two methods: limit cycle method and step response method.



Start auto tuning after the system becomes stable. If not, auto tuning may not be performed correctly.

### Limit cycle method

#### ■Control data set by auto tuning (limit cycle method)

- Proportional gain ( $K_P$ ): (s3)+3
- Integral time ( $T_I$ ): (s3)+4
- Derivative time ( $T_D$ ): (s3)+6

#### ■Procedure

**1.** Set the action of PID operation.

Set the action (direct action or reverse action) with the bit 0 of (s3)+1 (Action setting (ACT)).

**2.** Select the limit cycle method.

Turn on the bit 6 of (s3)+1 (Action setting (ACT)).

(When the bit is off, the step response method is selected.)

**3.** Turn on the auto tuning execution flag.

Turn on the bit 4 of (s3)+1 (Action setting (ACT)).

**4.** Set an input filter constant.

Set a value in (s3)+2 (Input filter ( $\alpha$ )).

**5.** Set a sampling time.

Set a value in (s3)+0 (Sampling time ( $T_S$ )).

**6.** Set the output upper limit value (ULV).

Set the upper limit of the manipulated value (MV) in (s3)+26 (Output upper limit value (ULV)).

**7.** Set the output lower limit value (LLV).

Set the lower limit of the manipulated value (MV) in (s3)+27 (Output lower limit value (LLV)).

**8.** Set the PV value threshold (hysteresis) width (SHPV).

Set a value in (s3)+25 (PV value threshold (hysteresis) width (SHPV)).

**9.** Set a set value (SV).

Set a set value (SV) in (s1) of the PID operation instruction.

**10.** Start auto tuning.

Auto tuning starts based on the process value (PV) when the start contact device of the PID operation instruction turns on.

The auto tuning related flags (bit 4 and bit 6) of (s3)+1 (Action setting (ACT)) turn off upon completion of auto tuning.

## Step response method

### ■Control data set by auto tuning (step response method)

- Direction (direct action/reverse action): Bit 0 of (s3)+1
- Proportional gain ( $K_P$ ): (s3)+3
- Integral time ( $T_I$ ): (s3)+4
- Derivative time ( $T_D$ ): (s3)+6

### ■Procedure

#### 1. Set the output value for auto tuning.

Transfer the output value for auto tuning to the manipulated value (MV).

Set the output value for auto tuning to the "maximum allowable output value of the external device  $\times 0.5$  to 1".

#### 2. Set the data that is not set by auto tuning.

Set the following items, which are not set by auto tuning, depending on the system.

| Setting item |                           | Remarks                                                                               |
|--------------|---------------------------|---------------------------------------------------------------------------------------|
| (s1)         | Set value (SV)            | Set a value so that the difference from the process value (PV) becomes 150 or more.*1 |
| (s3)         | Sampling time ( $T_S$ )   | Set a cycle to 1000ms or longer.*2                                                    |
| (s3)+2       | Input filter ( $\alpha$ ) | —                                                                                     |
| (s3)+5       | Derivative gain ( $K_D$ ) | When the input filter is used, set the derivative gain to 0.                          |
| Others       |                           | Set other control data as needed.                                                     |

\*1 Difference between the set value (SV) and the process value (PV)

To perform auto tuning correctly, the difference between the process value (PV) and the set value (SV) must be 150 or more at the time of auto tuning start. If the difference is less than 150, set a set value (SV) for auto tuning.

After completion of auto tuning, set the SV back to the original value.

\*2 Sampling time ( $T_S$ ) setting

To perform auto tuning, set the sampling time ( $T_S$ ) to 1000ms or longer.

The sampling time should also be sufficiently longer than the output change period.

#### 3. Start auto tuning.

Turn on the bit 4 of (s3)+1 (Action setting (ACT)) to start auto tuning.

When the amount of variation from the process value (PV) at start of auto tuning to the set value (SV) becomes 1/3 or more, auto tuning is completed and the bit 4 of (s3)+1 (Action setting (ACT)) turns off automatically.

## Precautions

- Measures to be taken when the process value (PV) does not change

If the process value (PV) does not change properly due to an analog input disconnection or any other problems, auto tuning does not end. Detect and avoid such problems by creating a program that monitors the input value and the elapsed time from the start of auto tuning.

## 23.2 PID Operation Instruction

23

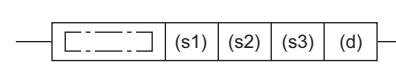
### PID

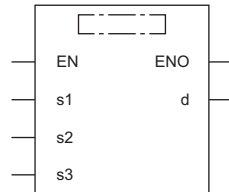
This instruction performs PID operation using the values set in (s1) to (s3), and stores the operation result in (d) at each cycle of sampling time.

#### Restriction

Before using the instruction, check the versions of the controller and engineering tool.

 User's manual for the controller used

| Ladder                                                                            | ST                       |
|-----------------------------------------------------------------------------------|--------------------------|
|  | ENO:=PID(EN,s1,s2,s3,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                                 |
|-------------|-------------------------------------------------------------------------------------|
| PID         |  |

### Setting data

### Description, range, data type

| Operand | Description                                    | Range           | Data type            | Data type (label) |
|---------|------------------------------------------------|-----------------|----------------------|-------------------|
| (s1)    | Device where the set value (SV) is stored      | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (s2)    | Device where the process value (PV) is stored  | -32768 to 32767 | 16-bit signed binary | ANY16             |
| (s3)    | Start device where the control data are stored | —               | 16-bit signed binary | ANY16             |
| (d)     | Device for storing the manipulated value (MV)  | -32768 to 32767 | 16-bit signed binary | ANY16             |
| EN      | Execution condition                            | —               | Bit                  | BOOL              |
| ENO     | Execution result                               | —               | Bit                  | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |                      |   | Double word |    | Indirect specification | Constant |   |    |   | Others |
|---------|----------------------------------|-----|---------------------------------------|----------------------|---|-------------|----|------------------------|----------|---|----|---|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□, U3E□\G□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |        |
| (s1)    | —                                | —   | ○                                     | ○                    | — | —           | —  | ○                      | —        | — | —  | — |        |
| (s2)    | —                                | —   | ○                                     | ○                    | — | —           | —  | ○                      | —        | — | —  | — |        |
| (s3)    | —                                | —   | ○                                     | —                    | — | —           | —  | ○                      | —        | — | —  | — |        |
| (d)     | —                                | —   | ○                                     | ○                    | — | —           | —  | ○                      | —        | — | —  | — |        |

### Processing details

When the set value (s1), process value (s2), and control data (s3) to (s3)+6 are set and a program is executed, the operation result, manipulated value (MV), is stored to (d) at every cycle of sampling time. For details, refer to the following.

 Page 1029 Overview

## ■Setting items (arguments)

| Setting item |                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Number of occupied points |
|--------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| (s1)         | Set value (SV)         | Set the set value (SV).<br>■Auto tuning (limit cycle method)<br>If the set value for auto tuning differs from that for normal PID control, set a value obtained by adding a bias value, and then set the SV back to the original value when the auto tuning flag turns off.                                                                                                                                                                                                                                                                                          | 1 point                   |
| (s2)         | Process value (PV)     | Set the input value for PID operation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1 point                   |
| (s3)         | Control data *1        | ■Auto tuning (limit cycle method)<br>The device areas of 29 points starting from the device specified in (s3) are used.                                                                                                                                                                                                                                                                                                                                                                                                                                              | 29 points                 |
|              |                        | ■Auto tuning (step response method)<br>The device areas of 25 points starting from the device specified in (s3) are used.                                                                                                                                                                                                                                                                                                                                                                                                                                            | 25 points                 |
| (d)          | Manipulated value (MV) | ■Normal PID control<br>The user sets the initial manipulated value before execution of the instruction. After execution, the operation result is stored.<br>■Auto tuning (limit cycle method)<br>During auto tuning, the output upper limit value (ULV) or output lower limit value (LLV) is output automatically. Upon completion of auto tuning, the given MV is set.<br>■Auto tuning (step response method)<br>The user sets the step manipulated value before execution of the instruction. During auto tuning, the MV cannot be changed by the PID instruction. | 1 point                   |

\*1 When auto tuning is not used, the same number of points are occupied as when the step response method is used.

## Setting items (control data)

| Operand: (s3)     |                                                                                                      |                                                             |                                                                                                     |
|-------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Device            | Item                                                                                                 | Description                                                 | Remarks                                                                                             |
| +0                | Sampling time ( $T_S$ )                                                                              | 1 to 32767 [ms]                                             | The sampling time must be longer than the operation cycle of the programmable controller.           |
| +1                | Action setting (ACT)                                                                                 | Bit 0                                                       | 0: Direct action<br>1: Reverse action                                                               |
|                   |                                                                                                      | Bit 1                                                       | 0: Input variation alarm disabled<br>1: Input variation alarm enabled                               |
|                   |                                                                                                      | Bit 2                                                       | 0: Output variation alarm disabled<br>1: Output variation alarm enabled                             |
|                   |                                                                                                      | Bit 3                                                       | Reserved                                                                                            |
|                   |                                                                                                      | Bit 4                                                       | 0: Auto tuning disabled<br>1: Auto tuning enabled                                                   |
|                   |                                                                                                      | Bit 5                                                       | 0: No output upper/lower limit value setting<br>1: Output upper/lower limit value setting enabled   |
|                   |                                                                                                      | Bit 6                                                       | 0: Step response method<br>1: Limit cycle method                                                    |
|                   |                                                                                                      | Bits 7 to 15                                                | Reserved                                                                                            |
| +2                | Input filter constant ( $\alpha$ )                                                                   | 0 to 99 [%]                                                 | 0 = No input filter                                                                                 |
| +3                | Proportional gain ( $K_P$ )                                                                          | 1 to 32767 [%]                                              | —                                                                                                   |
| +4                | Integral time ( $T_I$ )                                                                              | 1 to 32767 [ $\times$ 100ms]                                | 0 = $\infty$ (No integration)                                                                       |
| +5                | Derivative gain ( $K_D$ )                                                                            | 0 to 200 [%]                                                | 0 = No derivative gain                                                                              |
| +6                | Derivative time ( $T_D$ )                                                                            | 1 to 32767 [ $\times$ 10ms]                                 | 0 = No derivation                                                                                   |
| +7 to +19         | These areas are used for internal processing of PID operation, and therefore data cannot be changed. |                                                             |                                                                                                     |
| +20 <sup>*1</sup> | Input variation (increase) alarm setting value                                                       | 0 to 32767                                                  | Operation setting (ACT): (s3) +1<br>Enabled when bit 1 is 1                                         |
| +21 <sup>*1</sup> | Input variation (decrease) alarm setting value                                                       | 0 to 32767                                                  | Operation setting (ACT): (s3) +1<br>Enabled when bit 1 is 1                                         |
| +22 <sup>*1</sup> | Output variation (increase) alarm setting value                                                      | 0 to 32767                                                  | Operation setting (ACT): (s3) +1<br>Enabled when bit 2 is 1 and bit 5 is 0                          |
|                   | Output upper limit setting value                                                                     | -32768 to 32767                                             | Operation setting (ACT): (s3) +1<br>Enabled when bit 2 is 0 and bit 5 is 1                          |
| +23 <sup>*1</sup> | Output variation (decrease) alarm setting value                                                      | 0 to 32767                                                  | Operation setting (ACT): (s3) +1<br>Enabled when bit 2 is 1 and bit 5 is 0                          |
|                   | Output lower limit setting value                                                                     | -32768 to 32767                                             | Operation setting (ACT): (s3) +1<br>Enabled when bit 2 is 0 and bit 5 is 1                          |
| +24 <sup>*1</sup> | Alarm output                                                                                         | Bit 0                                                       | 0: Input variation (increase) not exceeded<br>1: Input variation (increase) exceeded                |
|                   |                                                                                                      | Bit 1                                                       | 0: Input variation (decrease) not exceeded<br>1: Input variation (decrease) exceeded                |
|                   |                                                                                                      | Bit 2                                                       | 0: Output variation (increase) not exceeded<br>1: Output variation (increase) exceeded              |
|                   |                                                                                                      | Bit 3                                                       | 0: Output variation (decrease) not exceeded<br>1: Output variation (decrease) exceeded              |
| +25 <sup>*2</sup> | PV value threshold (hysteresis) width (SHPV)                                                         | Set according to the fluctuation of the process value (PV). | Operation setting (ACT): (s3) +1<br>Occupied when bit 6 is 1 (with the limit cycle method selected) |
| +26 <sup>*2</sup> | Output upper limit value (ULV)                                                                       | Upper limit (ULV) of the manipulated value (MV)             |                                                                                                     |
| +27 <sup>*2</sup> | Output lower limit value (LLV)                                                                       | Lower limit (LLV) of the manipulated value (MV)             |                                                                                                     |
| +28 <sup>*2</sup> | Wait time setting parameter from the end of tuning cycle to the start of PID control ( $K_W$ )       | -50 to 32717 [%]                                            |                                                                                                     |

\*1 Occupied when the bit 1 of (s3)+1 (Action direction (ACT)) is 1, the bit 2 is 1, or the bit 5 is 1.

\*2 Occupied when the bit 6 of (s3)+1 (Action direction (ACT)) is 1 (limit cycle method).

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11A0H            | A value set for the sampling time ( $T_S$ ) is out of the range, $T_S \leq 0$ .                                                                                                                                                                                                                                                                                        |
| 11A1H            | A value set for the input filter constant ( $\alpha$ ) is out of the range, $\alpha < 0$ or $100 \leq \alpha$ .                                                                                                                                                                                                                                                        |
| 11A2H            | A value the proportional gain ( $K_P$ ) is out of the range, $K_P < 0$ .                                                                                                                                                                                                                                                                                               |
| 11A3H            | A value set for the integral time ( $T_I$ ) is out of the range, $T_I < 0$ .                                                                                                                                                                                                                                                                                           |
| 11A4H            | A value set for the derivative gain ( $K_D$ ) is out of the range, $K_D < 0$ or $201 \leq K_D$ .                                                                                                                                                                                                                                                                       |
| 11A5H            | A value set for the derivative time ( $T_D$ ) is out of the range, $T_D < 0$ .                                                                                                                                                                                                                                                                                         |
| 11A6H            | A value set for the sampling time ( $T_S$ ) is less than the operation cycle of the programmable controller.                                                                                                                                                                                                                                                           |
| 11A7H            | The process value variation ( $\Delta PV$ ) overflowed.                                                                                                                                                                                                                                                                                                                |
| 11A8H            | Deviation (EV) overflowed.                                                                                                                                                                                                                                                                                                                                             |
| 11A9H            | The calculated integral value overflowed.                                                                                                                                                                                                                                                                                                                              |
| 11AAH            | The derivative gain ( $K_D$ ) value overflowed.                                                                                                                                                                                                                                                                                                                        |
| 11ABH            | The calculated derivative value overflowed.                                                                                                                                                                                                                                                                                                                            |
| 11ACH            | The PID operation result overflowed.                                                                                                                                                                                                                                                                                                                                   |
| 11ADH            | A value less than the output lower limit value is set for the output upper limit value.                                                                                                                                                                                                                                                                                |
| 11AEH            | A value less than 0 is set for the input variation alarm setting value or output variation alarm setting value.                                                                                                                                                                                                                                                        |
| 11AFH            | <p>■Step response method</p> <p>Improper auto tuning result</p> <ul style="list-style-type: none"> <li>The deviation at the start of auto tuning (step response method) is 150 or less.</li> <li>The deviation at the end of auto tuning (step response method) is one-third or more of the deviation at the time of start.</li> </ul>                                 |
| 11B0H            | <p>■Step response method</p> <p>Auto tuning operation direction mismatch</p> <ul style="list-style-type: none"> <li>The action direction estimated according to the relation between the set value (SV) and the process value (PV) at the start of auto tuning (step response method) and the action direction of the manipulated value (MV) did not match.</li> </ul> |
| 11B1H            | <p>■Step response method</p> <p>Improper auto tuning operation</p> <ul style="list-style-type: none"> <li>Auto tuning (step response method) failed to operate correctly because the process value (PV) did not change properly.</li> </ul>                                                                                                                            |
| 11B2H            | <p>■Limit cycle method</p> <p>A value equal to or less than the output lower limit value (LLV) is set for the output upper limit value (ULV) for auto tuning (limit cycle method).</p>                                                                                                                                                                                 |
| 11B3H            | <p>■Limit cycle method</p> <p>A value set for the PV value threshold (hysteresis) width (SHPV) for auto tuning (limit cycle method) is out of the range, <math>SHPV &lt; 0</math>.</p>                                                                                                                                                                                 |
| 11B4H            | <p>■Limit cycle method</p> <p>The system area used for auto tuning (limit cycle method) has been overwritten.</p>                                                                                                                                                                                                                                                      |
| 11B5H            | <p>■Limit cycle method</p> <p>The measurement time for auto tuning (limit cycle method) has been exceeded, and <math>\tau</math> and <math>\tau_{on}</math> time cannot be obtained properly. (<math>\tau_{on} &gt; \tau</math>, <math>\tau_{on} &lt; 0</math>, <math>\tau &lt; 0</math>)</p>                                                                          |
| 11B6H            | <p>■Limit cycle method</p> <p>The proportional gain (<math>K_P</math>) calculated by auto tuning (limit cycle method) overflowed.</p>                                                                                                                                                                                                                                  |
| 11B7H            | <p>■Limit cycle method</p> <p>The integral time (<math>T_I</math>) calculated by auto tuning (limit cycle method) is out of the range, 0 to 32767.</p>                                                                                                                                                                                                                 |
| 11B8H            | <p>■Limit cycle method</p> <p>The derivative time (<math>T_D</math>) calculated by auto tuning (limit cycle method) is out of the range, 0 to 32767.</p>                                                                                                                                                                                                               |

# 24 PID CONTROL INSTRUCTIONS

This instruction is for PID control.

## 24.1 Overview

This section describes the operation methods, procedures, and helpful functions of PID control by using PID control instructions.

### Point

The PID control instructions include those for inexact differential and exact differential.

Inexact differential is PID control that applies a primary delay filter to the input of a differentiation term, and is useful for the following.

- For control susceptible to high-frequency noise
- When energy effective to actuate an operation end is not provided when a step change occurs in an exact differential system

Exact differential is PID control that uses the input of a differential term as it is.

## Operation method

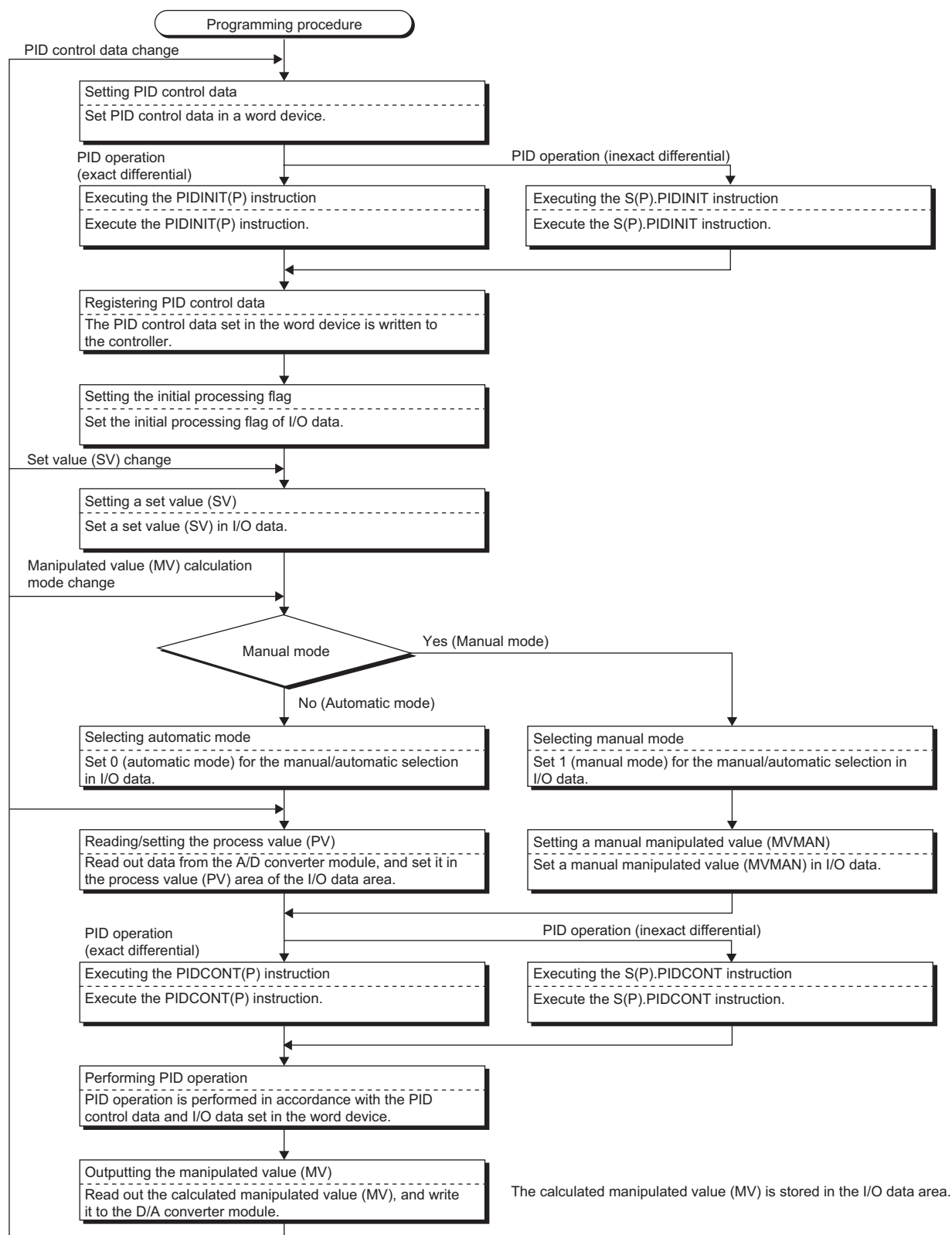
Two types of operation methods are available for PID control by using PID control instructions: velocity type and process value differentiation type.

The following table summarizes each operation methods.

| Operation method                   | Description                                                                                                                                                                                                                                                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Velocity type                      | This type of control calculates variations in the manipulated values (MV) during PID operation. The actual MV is the accumulated value of variations calculated each sampling period.                                                                                       |
| Process value differentiation type | This type of control performs PID operation by differentiating the process value (PV). Since the deviation is not subject to differentiation, an abrupt change in output due to derivative action can be reduced when the deviation is generated by changing the set value. |

# PID control procedure

Create a program for PID control following the procedure below. (Devices are used in the procedure.)





- PID control data can be registered or changed every scan of the program. Whenever the data are registered or changed, execute the PIDINIT instruction. If not executed, the registered or changed data are not used when the PIDCONT instruction is executed.
- Note that the PIDINIT instruction does not need to be executed if the PID control data are changed for the specified loop by using the PIDPRMW instruction.

## PID control data

PID control data is used to set the reference values for PID operation. The set values need to be registered to the controller by using the PIDINIT instruction before PID operation by the PIDCONT instruction starts. The PID control data can be set to a word device area with any numbers. Note that all the data for the number of loops used must be set in the area with consecutive device numbers.

For data assignment, refer to the following.

- Inexact differential:  Page 1056 S(P).PIDINIT
- Exact differential:  Page 1068 PIDINIT(P)

PID control data are classified into two types: data common to all loops and data for each loop.

| Type                     | Item                                                    | Description                                                                                                                                                                                                                                                                                                    | Setting range                                              | Processing when set data is out of the valid range                                                                                                                                                                            |
|--------------------------|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data common to all loops | Number of loops used                                    | Number of loops where PID operation is performed                                                                                                                                                                                                                                                               | 1 to 32                                                    | An error occurs, and PID operation is not performed for all loops.                                                                                                                                                            |
|                          | Number of loops in one scan                             | Number of loops to be used in one PID operation when multiple loops reach the sampling period at a same time                                                                                                                                                                                                   | 1 to 32                                                    |                                                                                                                                                                                                                               |
| Data for each loop       | Operational expression selection                        | Selects direct action or reverse action.                                                                                                                                                                                                                                                                       | 0: Direct action<br>1: Reverse action                      | An error occurs, and PID operation is not performed for the corresponding loop.                                                                                                                                               |
|                          | Sampling period ( $T_S$ )                               | Sets a cycle of PID operation.                                                                                                                                                                                                                                                                                 | 1 to 6000 (in increments of 10ms)                          |                                                                                                                                                                                                                               |
|                          | Proportional constant ( $K_P$ )                         | A constant of proportionality in PID operation                                                                                                                                                                                                                                                                 | 1 to 10000 (in increments of 0.01)                         |                                                                                                                                                                                                                               |
|                          | Integral constant ( $T_I$ )                             | A constant that expresses the magnitude of the integral action effect. Increasing the integral constant slows down the variation in the manipulated value.                                                                                                                                                     | 1 to 32767 (in increments of 100ms)                        |                                                                                                                                                                                                                               |
|                          | Derivative constant ( $T_D$ )                           | A constant that expresses the magnitude of the derivative action effect. Increasing the derivative constant causes a significant change in the manipulated value even with slight change of the control objective.                                                                                             | 0 to 30000 (in increments of 10ms)                         |                                                                                                                                                                                                                               |
|                          | Filter coefficient ( $\alpha$ )                         | Degree of filtering applied to the process value (input value from the A/D converter module). The filtering effect decreases as the value gets closer to 0.                                                                                                                                                    | 1 to 100                                                   |                                                                                                                                                                                                                               |
|                          | Manipulated value lower limit (MVLL)                    | Lower limit of the manipulated value (MV) calculated by PID operation in automatic mode. If the MV is smaller than the MVLL, the MVLL is used as the MV.                                                                                                                                                       | -50 to 2050 <sup>*1</sup><br>-32768 to 32767 <sup>*2</sup> | In the case of *1, if the MVLL or MVHL value is out of the valid range, it will be converted as follows.<br>• If the value is smaller than -50, -50 is used.<br>• If the value is bigger than 2050, 2050 is used.             |
|                          | Manipulated value upper limit (MVHL)                    | Upper limit of the manipulated value (MV) calculated by PID operation in automatic mode. If the MV is bigger than the MVHL, the MVHL is used as the MV.                                                                                                                                                        | -50 to 2050 <sup>*1</sup><br>-32768 to 32767 <sup>*2</sup> |                                                                                                                                                                                                                               |
|                          | Manipulated value variation rate limit ( $\Delta MVL$ ) | Limit of variation in the manipulated values calculated last time and this time. If the variation exceeds the limit, 1 is set to b1 of the alarm device. Note that the variation amount will not be limited actually. Even if the variation exceeds the limit, it is used as it is, and the MV is calculated.  | 0 to 2000 <sup>*1</sup><br>0 to 32767 <sup>*2</sup>        | In the case of *1, if the $\Delta MVL$ or $\Delta PVL$ value is out of the valid range, it will be converted as follows.<br>• If the value is smaller than 0, 0 is used.<br>• If the value is bigger than 2000, 2000 is used. |
|                          | Process value variation rate limit ( $\Delta PVL$ )     | Limit of variation in the process values input last time and this time. If the variation exceeds the limit, 1 is set to b0 of the alarm device. Note that the variation amount will not be limited actually. Even if the variation exceeds the limit, it is used as it is, and the PID operation is performed. | 0 to 2000 <sup>*1</sup><br>0 to 32767 <sup>*2</sup>        |                                                                                                                                                                                                                               |
|                          | Derivative gain ( $K_D$ ) <sup>*3</sup>                 | A time period (operation delay) for derivative action. The time period decreases as the value gets bigger. (The operation becomes closer to exact differential.)                                                                                                                                               | 0 to 32767 (in increments of 0.01)                         |                                                                                                                                                                                                                               |

\*1 When the PID limit is restricted

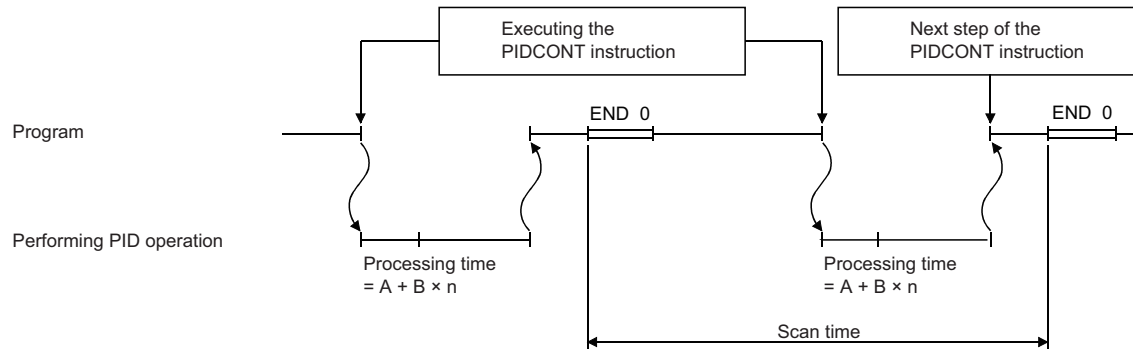
\*2 When the PID limit is not restricted

\*3 For PID control (inexact differential) only

## ■Number of loops used and number of execution loops in one scan

The number of loops used is the number of loops where PID operation is performed. The sampling period is measured for the set number of loops when the PIDCONT instruction is executed, and PID operation is performed for the loops that reach the specified sampling period.

Processing time of the PIDCONT instruction increases in proportion to the number of loops where PID operation is performed. The number of execution loops in one scan is the number of loops where PID operation is performed in one scan when there are multiple loops that reach the specified sampling period. If this number is set, PID operation is performed only for the set number of loops, and PID operation for the rest of the loops that reach the sampling period will be performed in the next scan.



A: Time required to measure sampling period

B: Time required to perform PID operation for a single loop

n: Number of loops

### Point

When the number of loops that reach the sampling period exceeds the number of execution loops in one scan, the priority order will be as follows:

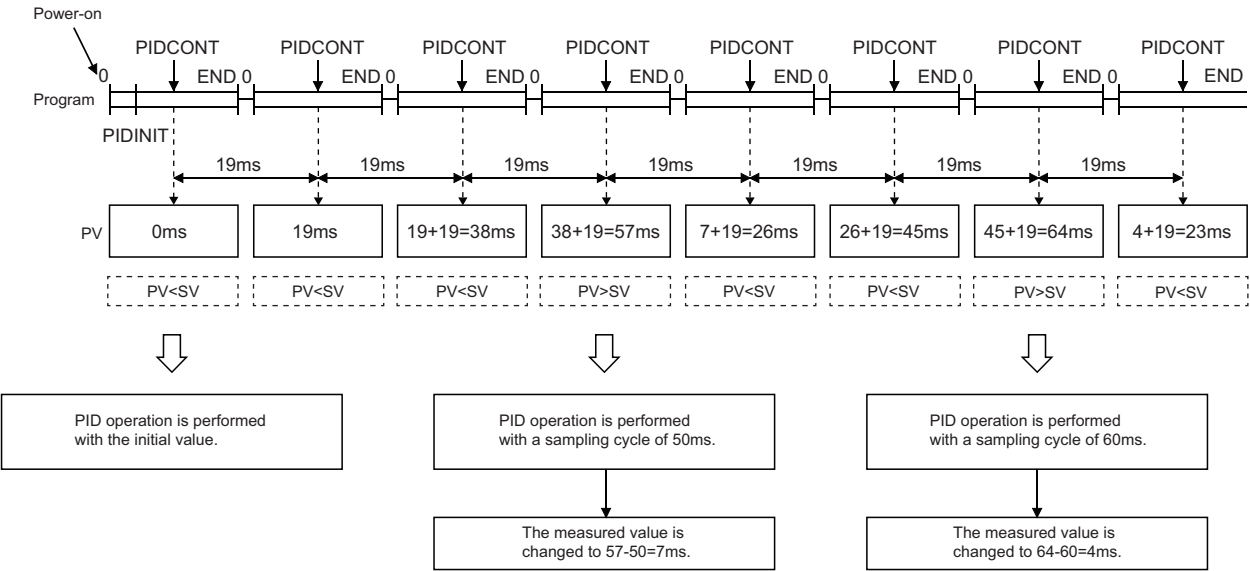
- The loop with the smallest loop number is given the highest priority.
- If there are loops where PID operation is performed and not performed in the last scan, the priority is given to the ones where PID operation is not performed in the last scan.

■Sampling period

Sampling period is a cycle in which PID operation is performed. The measurement time of a single scan is added to the total measurement time up to the last scan every time the PIDCONT instruction is executed. The total measurement time reaches or exceeds the set sampling period, PID operation of the corresponding loop is performed. Set the sampling period used in PID operation in increments of 10ms.

Ex.

When the sampling period is 50ms



PV: Measured value

SV: Set value

Restriction

Since the sampling period is measured at execution of the PIDCONT instruction, a value smaller than the program scan time cannot be set as the sampling period. If set, PID operation is performed with a scan time.

## I/O data

I/O data consists of input data, such as the set value (SV) and process value (PV), which are set to perform PID operation, and output data, such as operation results. The I/O data can be set to a word device area with any numbers. Note that all the data for the number of loops used must be set in the area with consecutive device numbers.

For data assignment, refer to the following.

- Inexact differential:  Page 1059 S(P).PIDCONT
- Exact differential:  Page 1070 PIDCONT(P)

The I/O data area is divided into two areas: data area assigned for each loop and work area used by the system.

| Item                          |                   | Description                                                                                                                                                                                                                                                                                                                                                                                         | Setting range                                                 | Remarks                                                                                                                                                                                                          |
|-------------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Set value                     | SV                | A target value in PID control                                                                                                                                                                                                                                                                                                                                                                       | 0 to 2000 <sup>*1</sup>                                       | In the case of *1, if the SV is out of the valid range, it will be converted as follows.<br>• If the value is smaller than 0, 0 is used.<br>• If the value is bigger than 2000, 2000 is used.                    |
|                               |                   |                                                                                                                                                                                                                                                                                                                                                                                                     | -32768 to 32767 <sup>*2</sup>                                 |                                                                                                                                                                                                                  |
| Process value                 | PV                | A feedback data from the control target to the A/D converter module                                                                                                                                                                                                                                                                                                                                 | -50 to 2050 <sup>*1</sup>                                     | In the case of *1, if the PV is out of the valid range, it will be converted as follows.<br>• If the value is smaller than -50, -50 is used.<br>• If the value is bigger than 2050, 2050 is used.                |
|                               |                   |                                                                                                                                                                                                                                                                                                                                                                                                     | -32768 to 32767 <sup>*2</sup>                                 |                                                                                                                                                                                                                  |
| Automatic manipulated value   | MV                | A manipulated value calculated by PID operation. The value is output from the D/A converter module to the control target.                                                                                                                                                                                                                                                                           | -50 to 2050 <sup>*1</sup>                                     | —                                                                                                                                                                                                                |
|                               |                   |                                                                                                                                                                                                                                                                                                                                                                                                     | -32768 to 32767 <sup>*2</sup>                                 |                                                                                                                                                                                                                  |
| Process value after filtering | PVf               | A process value calculated by the following operational expression<br>$PV_{fn} = PV_n + \alpha(PV_{fn-1} - PV_n)$                                                                                                                                                                                                                                                                                   | -50 to 2050 <sup>*1</sup>                                     | —                                                                                                                                                                                                                |
|                               |                   |                                                                                                                                                                                                                                                                                                                                                                                                     | -32768 to 32767 <sup>*2</sup>                                 |                                                                                                                                                                                                                  |
| Manual manipulated value      | MV <sub>MAN</sub> | Data output from the D/A converter module in manual mode                                                                                                                                                                                                                                                                                                                                            | -50 to 2050 <sup>*1</sup>                                     | In the case of *1, if the MV <sub>MAN</sub> is out of the valid range, it will be converted as follows.<br>• If the value is smaller than -50, -50 is used.<br>• If the value is bigger than 2050, 2050 is used. |
|                               |                   |                                                                                                                                                                                                                                                                                                                                                                                                     | -32768 to 32767 <sup>*2</sup>                                 |                                                                                                                                                                                                                  |
| Manual/automatic selection    | MAN/AUTO          | Select the type of output data to the D/A converter module: manual manipulated value or automatic manipulated value. In manual mode, the automatic manipulated value remains unchanged.                                                                                                                                                                                                             | 0: Automatic manipulated value<br>1: Manual manipulated value | An error occurs if the set value is other than 0 or 1, and PID operation of the corresponding loop is not executed.                                                                                              |
| Alarm                         | ALARM             | Checks whether the variation rate of the automatic manipulated value (MV) or process value (PV) is within the valid range or not. Once the value is set, it is held until the controller is reset.                                                                                                                                                                                                  | —                                                             | —                                                                                                                                                                                                                |
|                               |                   | <div><div><div>b15</div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div>b0</div></div><div>(2) (1)</div></div> <div>(1) If the PV is out of the limited range, 1 is set to b0.<br/>(2) If the MV is out of the limited range, 1 is set to b1.</div> |                                                               |                                                                                                                                                                                                                  |

\*1 When the PID limit is restricted

\*2 When the PID limit is not restricted

## Helpful functions

During PID operation by using PID control instructions, bumpless transfer and manipulated value upper/lower limit control are automatically executed.

### Bumpless transfer

This function controls the manipulated value (MV) continuously when the control mode is switched from manual to automatic, or vice-versa. When the mode is switched, data are transferred between the MV storage areas for manual mode and automatic mode.

- From manual to automatic: MV in manual mode is transferred to the MV storage area for automatic mode.
- From automatic to manual: MV in automatic mode is transferred to the MV storage area for manual mode.

Switch the mode in I/O data. (🔗 Page 1051 I/O data)

#### Point

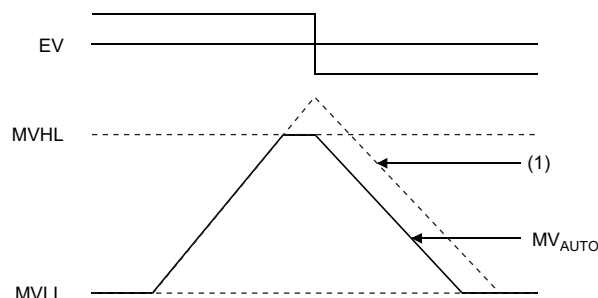
PID control is performed in each mode as described below.

- Automatic mode: The controller controls the target with the MV calculated by PID operation using the PID control instructions.
- Manual mode: The controller controls the target with the MV calculated without performing PID operation using the PID control instructions. Loops set in manual mode stores the process value (PV) in the set value storage area every sampling cycle.

### Manipulated value upper/lower limits control

This function controls the upper or lower limit of the manipulated value (MV) calculated by PID operation. The function is only enabled in automatic mode and is not executed in manual mode.

The manipulated value (MV) calculated by PID operation can be limited within the range set by the manipulated value upper limit (MVHL) and manipulated value lower limit (MVLL). The following figure shows the operation of the function.



(1)  $MV_{AUTO}$  without limit control

The manipulated value upper limit (MVHL) and manipulated value lower limit (MVLL) can be set to each loop within the range of -50 to 2050 or within any desired range. The following values are set by default.

- Manipulated value upper limit: 2000
- Manipulated value lower limit: 0

An error occurs if the MVHL is smaller than the MVLL.

## Transferring PV to SV in manual mode

This function executes the PIDCONT instruction even in manual mode. In manual mode, whether transferring the process value (PV) input from the A/D converter module to the set value (SV) storage area during execution of the PIDCONT instruction or not can be selected by turning on or off SM792 or SM794. SM792 and SM794 are set to off by default. The PV and SV are stored in the specified device or label in the I/O data area by using the PIDCONT instruction.

| SM792, SM794 | Operation                                                                                                                                                                                                                                                                                                                                                                            |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Off          | <ul style="list-style-type: none"> <li>The PV is transferred to the SV storage device or label during execution of the PIDCONT instruction.</li> <li>When the mode is switched to automatic mode, the MV output in manual mode is continued.</li> <li>If the SV is changed after the mode is switched to automatic mode, control from the MV output to the SV is enabled.</li> </ul> |
| On           | <ul style="list-style-type: none"> <li>The PV is not transferred to the SV storage device or label during execution of the PIDCONT instruction.</li> <li>When the mode is switched to automatic mode, control from the MV output in manual mode to the SV is enabled.</li> <li>Before switching to automatic mode, store the SV to the SV storage device or label.</li> </ul>        |

### Point

Depending on the on/off status of SM792 or SM794, the following differences apply when switching manual mode to automatic mode.

- When SM792 or SM794 is off, the PV is transferred to the SV storage device or label. Therefore, there is no difference between the PV and SV and an abrupt change does not occur in MV when the mode is switched. Note, however, that since the SV after the mode is switched differs from the target value in automatic mode, the user needs to change the SV step by step in the program so that it matches the target value.
- When SM792 or SM794 is on, the PV is not transferred to the SV storage device or label. Therefore, a difference exists between the PV and SV when the mode is switched. If the difference is large when the mode is switched, an abrupt change may occur in MV. Use this method in a system where the mode is switched when the PV has fully neared the SV. PID control in automatic mode can be executed immediately without the SV being changed step by step in the program.

## Changing the setting range of PID control data and I/O data

The setting range of PID control data and I/O data can be changed as desired.

To change the range, turn on the bit corresponding to the target loop in SD792, SD793, SD794, and SD795.

| Inexact differential | Exact differential | Operation                                                                                                                                                                                                                                                                                                                                                           |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|----------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| SD794                | SD792              | <div><div>b15b14b13b12b11b10b9b8b7b6b5b4b3b2b1b0</div><table><tr><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td></tr></table></div> <div>b0: Loop 1<br/>b1: Loop 2<br/>⋮<br/>b14: Loop 15<br/>b15: Loop 16</div>   | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 |
| 1/0                  | 1/0                | 1/0                                                                                                                                                                                                                                                                                                                                                                 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 |     |     |     |
| SD795                | SD793              | <div><div>b15b14b13b12b11b10b9b8b7b6b5b4b3b2b1b0</div><table><tr><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td><td>1/0</td></tr></table></div> <div>b0: Loop 17<br/>b1: Loop 18<br/>⋮<br/>b14: Loop 31<br/>b15: Loop 32</div> | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 |
| 1/0                  | 1/0                | 1/0                                                                                                                                                                                                                                                                                                                                                                 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 | 1/0 |     |     |     |

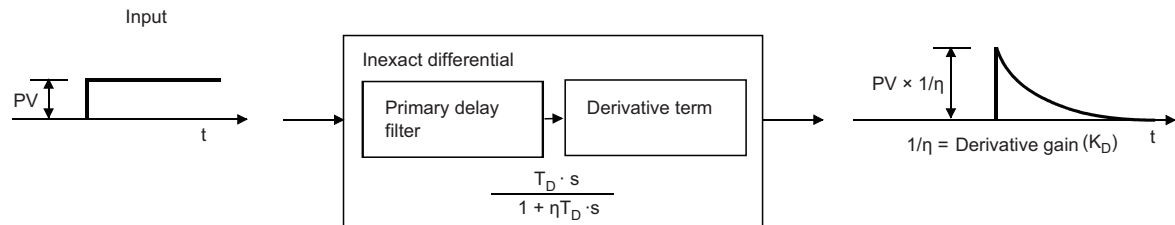
0: PID limit restricted (default)

1: PID limit not restricted

# 24.2 PID Control Instructions (Inexact Differential)

Inexact differential is PID control that applies a primary delay filter to the input of a differentiation term. Inexact differential is effective in the following cases:

- For control susceptible to high-frequency noise
- When energy effective to actuate an operation end is not provided when a step change occurs in an exact differential system

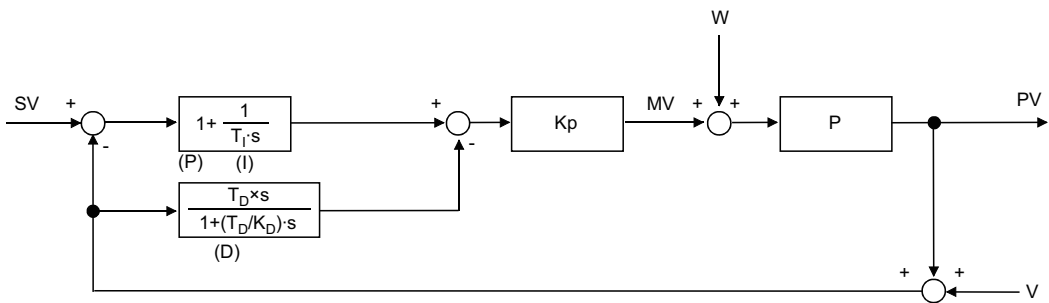


The following table summarizes the performance specifications of PID control instructions for inexact differential.

| Item                           |                       | When the PID limit is restricted | When the PID limit is not restricted                                                     |
|--------------------------------|-----------------------|----------------------------------|------------------------------------------------------------------------------------------|
| Number of PID control loops    |                       | —                                | 32 maximum                                                                               |
| Sampling period                |                       | $T_S$                            | 0.01 to 60.00s                                                                           |
| PID operation method           |                       | —                                | Process value differentiation type (inexact differential) (direct action/reverse action) |
| PID constants setting range    | Proportional constant | $K_P$                            | 0.01 to 100.00                                                                           |
|                                | Integral constant     | $T_I$                            | 0.1 to 3000.0s                                                                           |
|                                | Derivative constant   | $T_D$                            | 0.00 to 300.00s                                                                          |
|                                | Derivative gain       | $K_D$                            | 0.00 to 300.00                                                                           |
| Set value setting range        |                       | SV                               | 0 to 2000                                                                                |
| Process value setting range    |                       | PV                               | -50 to 2050                                                                              |
| Manipulated value output range |                       | MV                               | -32768 to 32767                                                                          |

The following are the block diagram and operational expressions of PID operation.

- Block diagram of PID operation (inexact differential)



$K_P$ : Gain  
 $W$ : Disturbance  
 $P$ : Controlled system  
 $V$ : Detected noise



• Operational expressions

| Action         | Operational expression                                                                                                                                                                                                                                                   |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Direct action  | $EV_n = PV_{fn} - SV$ $\Delta MV = K_p \{ (EV_n - EV_{n-1}) + \frac{T_s}{T_i} \cdot EV_n + D_n \}$ $D_n = \frac{T_D}{T_s + \frac{T_D}{K_D}} (PV_{fn} - 2PV_{fn-1} + PV_{fn-2}) + \frac{\frac{T_D}{K_D}}{T_s + \frac{T_D}{K_D}} \cdot D_{n-1}$ $MV_n = \Sigma \Delta MV$  |
| Reverse action | $EV_n = SV - PV_{fn}$ $\Delta MV = K_p \{ (EV_n - EV_{n-1}) + \frac{T_s}{T_i} \cdot EV_n + D_n \}$ $D_n = \frac{T_D}{T_s + \frac{T_D}{K_D}} (-PV_{fn} + 2PV_{fn-1} - PV_{fn-2}) + \frac{\frac{T_D}{K_D}}{T_s + \frac{T_D}{K_D}} \cdot D_{n-1}$ $MV_n = \Sigma \Delta MV$ |

The meaning of the symbols in the operational expressions is as follows.

| Symbol      | Meaning                                                                 |
|-------------|-------------------------------------------------------------------------|
| $EV_n$      | Deviation in the sampling period this time                              |
| $EV_{n-1}$  | Deviation in the sampling period last time                              |
| $SV$        | Set value                                                               |
| $PV_{fn}$   | Process value of the sampling period this time (after filtering)        |
| $PV_{fn-1}$ | Process value of the sampling period last time (after filtering)        |
| $PV_{fn-2}$ | Process value of the sampling period second last time (after filtering) |
| $\Delta MV$ | Output variation amount                                                 |
| $MV_n$      | Manipulated value this time                                             |
| $D_n$       | Derivative term this time                                               |
| $D_{n-1}$   | Derivative term of the sampling period last time                        |
| $T_s$       | Sampling period                                                         |
| $K_p$       | Proportional constant                                                   |
| $T_i$       | Integral constant                                                       |
| $T_D$       | Derivative constant                                                     |
| $K_D$       | Derivative gain                                                         |

The  $PV_{fn}$  is calculated by using the following operational expression. If the input filter coefficient is not set, the value will be the same as the input process value (PV).

$$PV_{fn} = PV_n + \alpha(PV_{fn-1} - PV_n)$$

$PV_n$ : Process value for the sampling period this time,  $\alpha$ : Filter coefficient,  $PV_{fn-1}$ : Process value for the sampling period last time (after filtering)

$PV_{fn}$  is stored in the I/O data area. (☞ Page 1051 I/O data)

# Registering the PID control data to the controller

## S(P).PIDINIT

These instructions store the PID control data by the number of loops used that is set in the specified device number and later altogether in the controller module.

| Ladder | ST                                                      |
|--------|---------------------------------------------------------|
|        | <pre>ENO:=S_PIDINIT(EN,s); ENO:=SP_PIDINIT(EN,s);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| S.PIDINIT   |                     |
| SP.PIDINIT  |                     |

### Setting data

#### Description, range, data type

| Operand | Description                                    | Range | Data type | Data type (label)   |
|---------|------------------------------------------------|-------|-----------|---------------------|
| (s)     | Start device where the PID control data is set | —     | Word      | ANY16 <sup>*1</sup> |
| EN      | Execution condition                            | —     | Bit       | BOOL                |
| ENO     | Execution result                               | —     | Bit       | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

#### Applicable devices

| Operand | Bit                              |      | Word                                  |             | Z | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions store the PID control data by the number of loops used that is set in the device number specified (s) and later altogether in the controller to enable PID control. (  Page 1048 PID control data)
- The PID control data are assigned as follows.

| Item                                   | PID control data |                                                                         |
|----------------------------------------|------------------|-------------------------------------------------------------------------|
| Common to all loops                    | (s)+0            | Number of loops used                                                    |
|                                        | (s)+1            | Number of loops in one scan                                             |
| For loop No.1 (14 words)               | (s)+2            | Operational expression selection                                        |
|                                        | (s)+3            | Sampling period ( $T_S$ )                                               |
|                                        | (s)+4            | Proportional constant ( $K_P$ )                                         |
|                                        | (s)+5            | Integral constant ( $T_I$ )                                             |
|                                        | (s)+6            | Derivative constant ( $T_D$ )                                           |
|                                        | (s)+7            | Filter coefficient ( $\alpha$ )                                         |
|                                        | (s)+8            | Manipulated value lower limit (MVLL)                                    |
|                                        | (s)+9            | Manipulated value upper limit (MVHL)                                    |
|                                        | (s)+10           | Manipulated value variation rate limit ( $\Delta$ MVL)                  |
|                                        | (s)+11           | Process value variation rate limit ( $\Delta$ PVL)                      |
|                                        | (s)+12           | Fixed to "0". (An error occurs if a value other than "0" is specified.) |
|                                        | (s)+13           | Derivative gain ( $K_D$ )                                               |
|                                        | (s)+14           | Fixed to "0". (An error occurs if a value other than "0" is specified.) |
|                                        | (s)+15           | Fixed to "0". (An error occurs if a value other than "0" is specified.) |
| ⋮                                      | ⋮                | ⋮                                                                       |
| For loop No.n (14 words) <sup>*1</sup> | (s)+(m+0)        | Operational expression selection                                        |
|                                        | (s)+(m+1)        | Sampling period ( $T_S$ )                                               |
|                                        | (s)+(m+2)        | Proportional constant ( $K_P$ )                                         |
|                                        | (s)+(m+3)        | Integral constant ( $T_I$ )                                             |
|                                        | (s)+(m+4)        | Derivative constant ( $T_D$ )                                           |
|                                        | (s)+(m+5)        | Filter coefficient ( $\alpha$ )                                         |
|                                        | (s)+(m+6)        | Manipulated value lower limit (MVLL)                                    |
|                                        | (s)+(m+7)        | Manipulated value upper limit (MVHL)                                    |
|                                        | (s)+(m+8)        | Manipulated value variation rate limit ( $\Delta$ MVL)                  |
|                                        | (s)+(m+9)        | Process value variation rate limit ( $\Delta$ PVL)                      |
|                                        | (s)+(m+10)       | Fixed to "0". (An error occurs if a value other than "0" is specified.) |
|                                        | (s)+(m+11)       | Derivative gain ( $K_D$ )                                               |
|                                        | (s)+(m+12)       | Fixed to "0". (An error occurs if a value other than "0" is specified.) |
|                                        | (s)+(m+13)       | Fixed to "0". (An error occurs if a value other than "0" is specified.) |

\*1  $m = (n-1) \times 14 + 2$

(1) Fixed to "0". An error results if a value other than "0" is specified.

- The number of device points used for PID control data setting is calculated by the following formula.

Number of device points =  $2 + 14 \times n$  (n: number of loops used)

- Specify each data in binary.
- If the total number of device points for the number of loops used exceeds the last device number, an error occurs and no processing is performed.
- If the S(P).PIDINIT instruction is executed at two or more locations during a single scan, the setting value of the S(P).PIDINIT instruction executed nearest to the S(P).PIDCONT instruction will be valid.
- Execute the S(P).PIDINIT instruction before execution of the S(P).PIDCONT instruction. To perform PID control, the S(P).PIDINIT instruction must be executed.

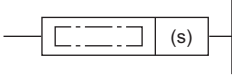
## Operation error

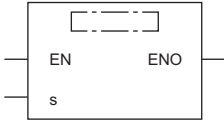
| Error code<br>(SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H               | <p>Out-of-range data is set in the device specified by (s).</p> <ul style="list-style-type: none"><li>• The value set for the PID control data is out of the setting range.</li><li>• (Number of loops used) &lt; (Number of loops executed in one scan)</li><li>• (Manipulated value upper limit) &lt; (Manipulated value lower limit)</li><li>• The area fixed to 0 in the PID control data is not 0.</li></ul> |

## Performing PID operation

### S(P).PIDCONT

These instructions measure the sampling cycle and perform PID operation when the execution command turns on.

| Ladder                                                                            | ST                                                      |
|-----------------------------------------------------------------------------------|---------------------------------------------------------|
|  | <pre>ENO:=S_PIDCONT(EN,s); ENO:=SP_PIDCONT(EN,s);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| S.PIDCONT   |  |
| SP.PIDCONT  |  |

### Setting data

### Description, range, data type

| Operand | Description                                | Range | Data type | Data type (label)   |
|---------|--------------------------------------------|-------|-----------|---------------------|
| (s)     | Start device assigned to the I/O data area | —     | Word      | ANY16 <sup>*1</sup> |
| EN      | Execution condition                        | —     | Bit       | BOOL                |
| ENO     | Execution result                           | —     | Bit       | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- The S(P).PIDCONT instructions measure the sampling cycle and perform PID operation.
- Based on the setting value (SV) and process value (PV) in the I/O data area allocated to the device number specified by (s) and later, these instructions perform PID operation and store the operation result in the automatic manipulated value (MV) area in the I/O data area.
- The S(P).PIDCONT instructions perform PID operation when it is executed for the first time after a lapse of the specified sampling cycle.
- During PID control, be sure to turn on the control command to allow the S(P).PIDCONT instruction to be executed every scan. Failure to execute the instruction every scan disables PID operation in normal sampling cycles. The S(P).PIDCONT instruction cannot be executed more than once in a single scan. Executing the instruction more than once in a single scan disables PID operation in normal sampling cycles.
- The S(P).PIDCONT instruction cannot be written and used in interrupt programs. Writing an S(P).PIDCONT instruction in the interrupt program disables PID operation in normal sampling cycles.
- In (s), specify the head of the device number specified in the I/O data area. (  Page 1051 I/O data)
- If a file register is specified as an I/O data area, do not apply memory protection for the file register. If memory protection is applied, normal PID operation is disabled although no error results.
- The I/O data are assigned as follows.

| Item                                                       |                     | I/O data   |                                                |
|------------------------------------------------------------|---------------------|------------|------------------------------------------------|
| Write                                                      |                     | (s)+0      | Initial processing flag                        |
| Read/write disabled                                        |                     | (s)+1      | Work area for PID control<br>(system use only) |
|                                                            |                     | ⋮          |                                                |
|                                                            |                     | (s)+9      |                                                |
| I/O data area for loop<br>No.1<br>(23 words)               | Write               | (s)+10     | Set value (SV)                                 |
|                                                            |                     | (s)+11     | Process value (PV)                             |
|                                                            | Read                | (s)+12     | Automatic manipulated value (MV)               |
|                                                            |                     | (s)+13     | Process value after filtering (PVf)            |
|                                                            | Write               | (s)+14     | Manual manipulated value (MV <sub>MAN</sub> )  |
|                                                            |                     | (s)+15     | Manual/automatic selection (MAN/AUTO)          |
|                                                            | Read/write          | (s)+16     | Alarm (ALARM)                                  |
|                                                            | Read/write disabled | (s)+17     | Work area for loop No.1<br>(system use only)   |
|                                                            |                     | ⋮          |                                                |
|                                                            |                     | (s)+32     |                                                |
| ⋮                                                          | ⋮                   | ⋮          | ⋮                                              |
| I/O data area for loop<br>No.n<br>(23 words) <sup>*1</sup> | Write               | (s)+(m+0)  | Set value (SV)                                 |
|                                                            |                     | (s)+(m+1)  | Process value (PV)                             |
|                                                            | Read                | (s)+(m+2)  | Automatic manipulated value (MV)               |
|                                                            |                     | (s)+(m+3)  | Process value after filtering (PVf)            |
|                                                            | Write               | (s)+(m+4)  | Manual manipulated value (MV <sub>MAN</sub> )  |
|                                                            |                     | (s)+(m+5)  | Manual/automatic selection (MAN/AUTO)          |
|                                                            | Read/write          | (s)+(m+6)  | Alarm (ALARM)                                  |
|                                                            | Read/write disabled | (s)+(m+7)  | Work area for loop No.n<br>(system use only)   |
|                                                            |                     | ⋮          |                                                |
|                                                            |                     | (s)+(m+22) |                                                |

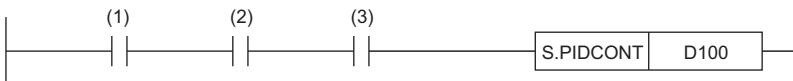
\*1  $m = (n-1) \times 23 + 10$

- The number of device points used for I/O data setting is calculated by the following formula.

Number of device points =  $10 + 23 \times n$  (n: number of loops used)

- Specify each data in binary.
- The initial processing flag sets the processing to be performed at the start of PID operation.
  - Initial operation processing is performed assuming that the sampling cycle that has been set has been reached.
  - If the initial processing flag is 0, PID operations for the number of loops used are performed altogether in a single scan. If it is not 0, PID operations for the number of loops used are divided and processed in several scans, and sampling is started sequentially from the loop that has completed initial processing. The number of processing loops per scan is the number of execution loops per scan that has been set.

- Write data to the I/O data "Write" area by users with the program. Users can read data from the I/O data "Read" area with the program. Never attempt to write data to the area indicated by "Read/write disabled" or "Read"; otherwise, normal operation can no longer be performed. Note that, when starting control from the initial status, the data areas must be cleared by the program.
- If the total number of device points for the number of loops used exceeds the last device number, an error occurs and no processing is performed.
- Even when the manual manipulated value ( $MV_{MAN}$ ) is output in manual mode, execute the S(P).PIDCONT instruction every scan. Unless the S(P).PIDCONT instruction is executed, the bumpless function cannot be performed.
- Apply an interlock using the READY signal of each module so that the S(P).PIDCONT instruction is executed only when the A/D converter module used to obtain the process value (PV) and the D/A converter module used to output the manipulated value (MV) are normal.



- (1) Control command  
 (2) READY signal of the A/D converter module  
 (3) READY signal of the D/A converter module

If the instruction is executed when these modules are not normal, PID operation cannot be performed normally as the result of failure in normal acquisition of process values (PV) or in normal output of manipulated values (MV).

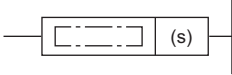
## Operation error

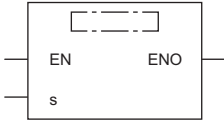
| Error code (SD0) | Description                                                                                  |
|------------------|----------------------------------------------------------------------------------------------|
| 3285H            | The value of the data set in the I/O data area specified by (s) is out of the setting range. |
| 3292H            | The S(P).PIDINIT instruction is not executed before the S(P).PIDCONT instruction.            |

# Stopping the operation of specified loop number

## S(P).PIDSTOP

These instructions stop the PID operation of the specified loop number.

| Ladder                                                                            | ST                                              |
|-----------------------------------------------------------------------------------|-------------------------------------------------|
|  | ENO:=S_PIDSTOP(EN,s);<br>ENO:=SP_PIDSTOP(EN,s); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| S.PIDSTOP   |  |
| SP.PIDSTOP  |  |

### Setting data

### Description, range, data type

| Operand | Description               | Range   | Data type              | Data type (label) |
|---------|---------------------------|---------|------------------------|-------------------|
| (s)     | Loop number to be stopped | 1 to 32 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition       | —       | Bit                    | BOOL              |
| ENO     | Execution result          | —       | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —      |

### Processing details

- These instructions stop the PID operation of the loop number in the device specified by (s). The loop stopped by the S(P).PIDSTOP instruction does not restart PID operation even if the S(P).PIDINIT instruction is executed.
- Each instruction holds operation data while the loop is stopped.

### Operation error

| Error code (SD0) | Description                                                                                                                                                                                           |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | Out-of-range data is set in the device specified by (s). <ul style="list-style-type: none"><li>The specified loop number does not exist.</li><li>The specified value is other than 1 to 32.</li></ul> |
| 3292H            | The S(P).PIDINIT and S(P).PIDCONT instructions are not executed before the S(P).PIDSTOP instruction.                                                                                                  |



## Starting the operation of specified loop number

### S(P).PIDRUN

These instructions start the PID operation of the specified loop number.

| Ladder | ST                                            |
|--------|-----------------------------------------------|
|        | ENO:=S_PIDRUN(EN,s);<br>ENO:=SP_PIDRUN(EN,s); |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| S.PIDRUN    |                     |
| SP.PIDRUN   |                     |

### Setting data

### Description, range, data type

| Operand | Description               | Range   | Data type              | Data type (label) |
|---------|---------------------------|---------|------------------------|-------------------|
| (s)     | Loop number to be stopped | 1 to 32 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition       | —       | Bit                    | BOOL              |
| ENO     | Execution result          | —       | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —      |

### Processing details

- These instructions start the PID operation of the loop number in the device specified by (s). These instructions are used to re-execute the PID operation of the loop number that has been stopped by the S(P).PIDSTOP instruction.
- The S(P).PIDRUN instruction, if executed for a loop number already in progress of PID operation, performs no processing.

### Operation error

| Error code (SD0) | Description                                                                                         |
|------------------|-----------------------------------------------------------------------------------------------------|
| 3285H            | The loop number specified by (s) does not exist.<br>(s) is outside the range from 1 to 32.          |
| 3292H            | The S(P).PIDINIT and S(P).PIDCONT instructions are not executed before the S(P).PIDRUN instruction. |

# Changing the parameters of specified loop number

## S(P).PIDPRMW

These instructions change the operation parameter of the specified loop number to the PID control data stored in the specified device number and later.

| Ladder | ST                                                              |
|--------|-----------------------------------------------------------------|
|        | <pre>ENO:=S_PIDPRMW(EN,s1,s2); ENO:=SP_PIDPRMW(EN,s1,s2);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| S.PIDPRMW   |                     |
| SP.PIDPRMW  |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                     | Range   | Data type              | Data type (label)   |
|---------|-----------------------------------------------------------------|---------|------------------------|---------------------|
| (s1)    | Loop number to be changed                                       | 1 to 32 | 16-bit unsigned binary | ANY16               |
| (s2)    | Start device where the change-target PID control data is stored | —       | Word                   | ANY16 <sup>*1</sup> |
| EN      | Execution condition                                             | —       | Bit                    | BOOL                |
| ENO     | Execution result                                                | —       | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions changes the operation parameter of the loop number in the device specified by (s1) to the PID control data stored in the device number specified by (s2) and later.
- The following figure shows the configuration of the PID control data in the device specified by (s2) and later.

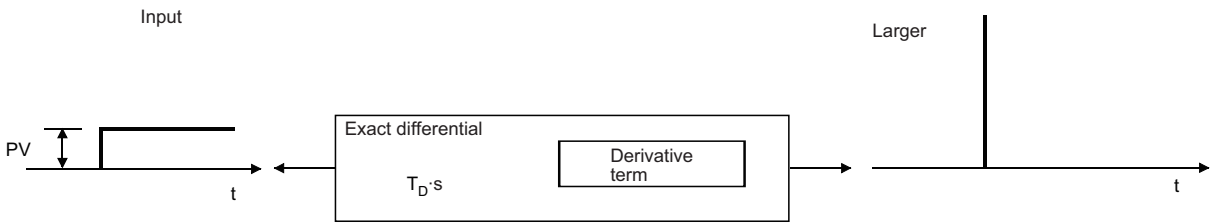
| PID control data |                                                         |
|------------------|---------------------------------------------------------|
| (s2)+0           | Operational expression selection                        |
| (s2)+1           | Sampling period ( $T_S$ )                               |
| (s2)+2           | Proportional constant ( $K_P$ )                         |
| (s2)+3           | Integral constant ( $T_I$ )                             |
| (s2)+4           | Derivative constant ( $T_D$ )                           |
| (s2)+5           | Filter coefficient ( $\alpha$ )                         |
| (s2)+6           | Manipulated value lower limit (MVLL)                    |
| (s2)+7           | Manipulated value upper limit (MVHL)                    |
| (s2)+8           | Manipulated value variation rate limit ( $\Delta MVL$ ) |
| (s2)+9           | Process value variation rate limit ( $\Delta PVL$ )     |
| (s2)+10          | 0                                                       |
| (s2)+11          | Derivative gain ( $K_D$ )                               |
| (s2)+12          | 0                                                       |
| (s2)+13          | 0                                                       |

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                         |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | Out-of-range data is set in the device specified by (s1). <ul style="list-style-type: none"> <li>• The specified loop number does not exist.</li> <li>• The specified value is other than 1 to 32.</li> </ul>                                                       |
|                  | Out-of-range data is set in the device specified by (s2). <ul style="list-style-type: none"> <li>• The PID control data is out of the setting range.</li> <li>• The PID control data in the devices specified by (s2)+10, (s2)+12, and (s2)+13 is not 0.</li> </ul> |
| 3292H            | The S(P).PIDINIT instruction is not executed before the S(P).PIDPRMW instruction.                                                                                                                                                                                   |

# 24.3 PID Control Instructions (Exact Differential)

Exact differential is PID control that uses the input of a differential term as it is.

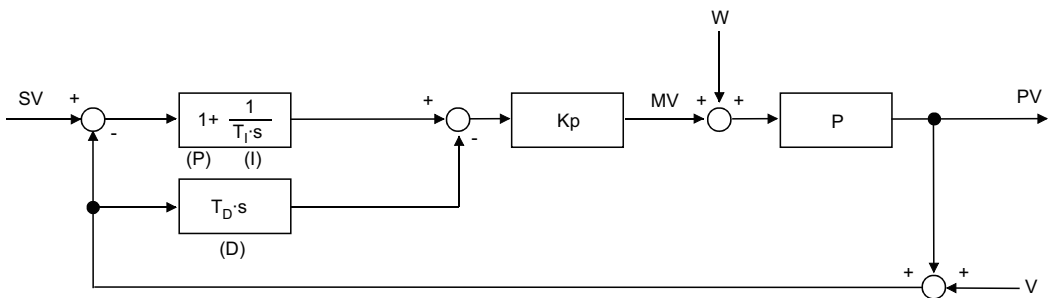


The following table summarizes the performance specifications of PID control instructions for exact differential.

| Item                           |                       | When the PID limit is restricted | When the PID limit is not restricted                                                   |
|--------------------------------|-----------------------|----------------------------------|----------------------------------------------------------------------------------------|
| Number of PID control loops    |                       | —                                | 32 maximum                                                                             |
| Sampling period                |                       | $T_S$                            | 0.01 to 60.00s                                                                         |
| PID operation method           |                       | —                                | Process value differentiation type (exact differential) (direct action/reverse action) |
| PID constants setting range    | Proportional constant | $K_P$                            | 0.01 to 100.00                                                                         |
|                                | Integral constant     | $T_I$                            | 0.1 to 3000.0s                                                                         |
|                                | Derivative constant   | $T_D$                            | 0.00 to 300.00s                                                                        |
| Set value setting range        |                       | SV                               | 0 to 2000                                                                              |
| Process value setting range    |                       | PV                               | -50 to 2050                                                                            |
| Manipulated value output range |                       | MV                               | -32768 to 32767                                                                        |

The following are the block diagram and operational expressions of PID operation.

- Block diagram of PID operation (exact differential)



$K_P$ : Gain  
 $W$ : Disturbance  
 $P$ : Controlled system  
 $V$ : Detected noise

• Operational expressions

| Action         | Operational expression                                                                                                                                                                              |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Direct action  | $EV_n = PV_{fn} - SV$ $\Delta MV = K_p \left\{ (EV_n - EV_{n-1}) + \frac{T_s}{T_i} \cdot EV_n + D_n \right\}$ $D_n = \frac{T_D}{T_s} (PV_{fn} - 2PV_{fn-1} + PV_{fn-2})$ $MV_n = \Sigma \Delta MV$  |
| Reverse action | $EV_n = SV - PV_{fn}$ $\Delta MV = K_p \left\{ (EV_n - EV_{n-1}) + \frac{T_s}{T_i} \cdot EV_n + D_n \right\}$ $D_n = \frac{T_D}{T_s} (-PV_{fn} + 2PV_{fn-1} - PV_{fn-2})$ $MV_n = \Sigma \Delta MV$ |

The meaning of the symbols in the operational expressions is as follows.

| Symbol      | Meaning                                                                 |
|-------------|-------------------------------------------------------------------------|
| $EV_n$      | Deviation in the sampling period this time                              |
| $EV_{n-1}$  | Deviation in the sampling period last time                              |
| $SV$        | Set value                                                               |
| $PV_{fn}$   | Process value of the sampling period this time (after filtering)        |
| $PV_{fn-1}$ | Process value of the sampling period last time (after filtering)        |
| $PV_{fn-2}$ | Process value of the sampling period second last time (after filtering) |
| $\Delta MV$ | Output variation amount                                                 |
| $MV_n$      | Manipulated value this time                                             |
| $D_n$       | Derivative term this time                                               |
| $T_s$       | Sampling period                                                         |
| $K_p$       | Proportional constant                                                   |
| $T_i$       | Integral constant                                                       |
| $T_D$       | Derivative constant                                                     |

The  $PV_{fn}$  is calculated by using the following operational expression. If the input filter coefficient is not set, the value will be the same as the input process value (PV).

$$PV_{fn} = PV_n + \alpha(PV_{fn-1} - PV_n)$$

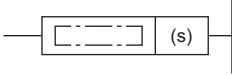
$PV_n$ : Process value for the sampling period this time,  $\alpha$ : Filter coefficient,  $PV_{fn-1}$ : Process value for the sampling period last time (after filtering)

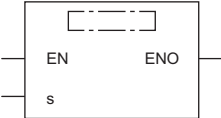
$PV_{fn}$  is stored in the I/O data area. (  Page 1051 I/O data)

# Registering the PID control data to the controller

## PIDINIT(P)

These instructions store the PID control data by the number of loops used that is set in the specified device number and later altogether in the controller module.

| Ladder                                                                            | ST                                                  |
|-----------------------------------------------------------------------------------|-----------------------------------------------------|
|  | <pre>ENO:=PIDINIT(EN,s); ENO:=PIDINITP(EN,s);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| PIDINIT     |  |
| PIDINITP    |  |

## Setting data

## Description, range, data type

| Operand | Description                                    | Range | Data type | Data type (label)   |
|---------|------------------------------------------------|-------|-----------|---------------------|
| (s)     | Start device where the PID control data is set | —     | Word      | ANY16 <sup>*1</sup> |
| EN      | Execution condition                            | —     | Bit       | BOOL                |
| ENO     | Execution result                               | —     | Bit       | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

## Applicable devices

| Operand | Bit                              |      | Word                                  |             | Z | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions store the PID control data by the number of loops used that is set in the device number specified (s) and later altogether in the controller to enable PID control. (  Page 1048 PID control data)
- The PID control data are assigned as follows.

| Item                                   | PID control data |                                                        |
|----------------------------------------|------------------|--------------------------------------------------------|
| Common to all loops                    | (s)+0            | Number of loops used                                   |
|                                        | (s)+1            | Number of loops in one scan                            |
| For loop No.1 (10 words)               | (s)+2            | Operational expression selection                       |
|                                        | (s)+3            | Sampling period ( $T_S$ )                              |
|                                        | (s)+4            | Proportional constant ( $K_P$ )                        |
|                                        | (s)+5            | Integral constant ( $T_I$ )                            |
|                                        | (s)+6            | Derivative constant ( $T_D$ )                          |
|                                        | (s)+7            | Filter coefficient ( $\alpha$ )                        |
|                                        | (s)+8            | Manipulated value lower limit (MVLL)                   |
|                                        | (s)+9            | Manipulated value upper limit (MVHL)                   |
|                                        | (s)+10           | Manipulated value variation rate limit ( $\Delta$ MVL) |
|                                        | (s)+11           | Process value variation rate limit ( $\Delta$ PVL)     |
| ⋮                                      | ⋮                | ⋮                                                      |
| For loop No.n (10 words) <sup>*1</sup> | (s)+(m+0)        | Operational expression selection                       |
|                                        | (s)+(m+1)        | Sampling period ( $T_S$ )                              |
|                                        | (s)+(m+2)        | Proportional constant ( $K_P$ )                        |
|                                        | (s)+(m+3)        | Integral constant ( $T_I$ )                            |
|                                        | (s)+(m+4)        | Derivative constant ( $T_D$ )                          |
|                                        | (s)+(m+5)        | Filter coefficient ( $\alpha$ )                        |
|                                        | (s)+(m+6)        | Manipulated value lower limit (MVLL)                   |
|                                        | (s)+(m+7)        | Manipulated value upper limit (MVHL)                   |
|                                        | (s)+(m+8)        | Manipulated value variation rate limit ( $\Delta$ MVL) |
|                                        | (s)+(m+9)        | Process value variation rate limit ( $\Delta$ PVL)     |

\*1  $m = (n-1) \times 10 + 2$

- The number of device points used for PID control data setting is calculated by the following formula.

Number of device points =  $2 + 10 \times n$  (n: number of loops used)

- Specify each data in binary.
- If the total number of device points for the number of loops used exceeds the last device number, an error occurs and no processing is performed.
- If the PIDINIT(P) instruction is executed at two or more locations during a single scan, the setting value of the PIDINIT(P) instruction executed nearest to the PIDCONT(P) instruction will be valid.
- Execute the PIDINIT(P) instruction before execution of the PIDCONT(P) instruction. To perform PID control, the PIDINIT(P) instruction must be executed.

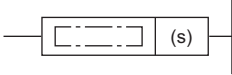
## Operation error

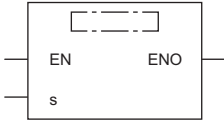
| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                            |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | <p>Out-of-range data is set in the device specified by (s).</p> <ul style="list-style-type: none"> <li>• The value set for the PID control data is out of the setting range.</li> <li>• (Number of loops used) &lt; (number of execution loops in one scan)</li> <li>• (Manipulated value upper limit) &lt; (Manipulated value lower limit)</li> </ul> |

# Performing PID operation

## PIDCONT(P)

These instructions measure the sampling cycle and perform PID operation when the execution command turns on.

| Ladder                                                                            | ST                                                  |
|-----------------------------------------------------------------------------------|-----------------------------------------------------|
|  | <pre>ENO:=PIDCONT(EN,s); ENO:=PIDCONTP(EN,s);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| PIDCONT     |  |
| PIDCONTP    |  |

### Setting data

### Description, range, data type

| Operand | Description                                | Range | Data type | Data type (label)   |
|---------|--------------------------------------------|-------|-----------|---------------------|
| (s)     | Start device assigned to the I/O data area | —     | Word      | ANY16 <sup>*1</sup> |
| EN      | Execution condition                        | —     | Bit       | BOOL                |
| ENO     | Execution result                           | —     | Bit       | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —      |



## Processing details

- The PIDCONT(P) instructions measure the sampling cycle and perform PID operation.
- Based on the setting value (SV) and process value (PV) in the I/O data area allocated to the device number specified by (s) and later, these instructions perform PID operation and store the operation result in the automatic manipulated value (MV) area in the I/O data area.
- The PIDCONT(P) instructions perform PID operation when it is executed for the first time after a lapse of the specified sampling cycle.
- During PID control, be sure to turn on the control command to allow the PIDCONT(P) instruction to be executed every scan. Failure to execute the instruction every scan disables PID operation in normal sampling cycles. The PIDCONT(P) instruction cannot be executed more than once in a single scan. Executing the instruction more than once in a single scan disables PID operation in normal sampling cycles.
- The PIDCONT(P) instruction cannot be written and used in interrupt programs. Writing a PIDCONT(P) instruction in the interrupt program disables PID operation in normal sampling cycles.
- In (s), specify the head of the device number specified in the I/O data area. (  Page 1051 I/O data)
- If a file register is specified as an I/O data area, do not apply memory protection for the file register. If memory protection is applied, normal PID operation is disabled although no error results.
- The I/O data are assigned as follows.

| Item                                                       |                     | I/O data   |                                                |
|------------------------------------------------------------|---------------------|------------|------------------------------------------------|
| Write                                                      |                     | (s)+0      | Initial processing flag                        |
| Read/write disabled                                        |                     | (s)+1      | Work area for PID control<br>(system use only) |
|                                                            |                     | ⋮          |                                                |
|                                                            |                     | (s)+9      |                                                |
| I/O data area for loop<br>No.1<br>(18 words)               | Write               | (s)+10     | Set value (SV)                                 |
|                                                            |                     | (s)+11     | Process value (PV)                             |
|                                                            | Read                | (s)+12     | Manual manipulated value (MV)                  |
|                                                            |                     | (s)+13     | Process value after filtering (PVf)            |
|                                                            | Write               | (s)+14     | Manual manipulated value (MV <sub>MAN</sub> )  |
|                                                            |                     | (s)+15     | Manual/automatic selection (MAN/AUTO)          |
|                                                            | Read/write          | (s)+16     | Alarm (ALARM)                                  |
|                                                            | Read/write disabled | (s)+17     | Work area for loop No.1<br>(system use only)   |
|                                                            |                     | ⋮          |                                                |
|                                                            |                     | (s)+27     |                                                |
| ⋮                                                          | ⋮                   | ⋮          | ⋮                                              |
| I/O data area for loop<br>No.n<br>(18 words) <sup>*1</sup> | Write               | (s)+(m+0)  | Set value (SV)                                 |
|                                                            |                     | (s)+(m+1)  | Process value (PV)                             |
|                                                            | Read                | (s)+(m+2)  | Automatic manipulated value (MV)               |
|                                                            |                     | (s)+(m+3)  | Process value after filtering (PVf)            |
|                                                            | Write               | (s)+(m+4)  | Manual manipulated value (MV <sub>MAN</sub> )  |
|                                                            |                     | (s)+(m+5)  | Manual/automatic selection (MAN/AUTO)          |
|                                                            | Read/write          | (s)+(m+6)  | Alarm (ALARM)                                  |
|                                                            | Read/write disabled | (s)+(m+7)  | Work area for loop No.n<br>(system use only)   |
|                                                            |                     | ⋮          |                                                |
|                                                            |                     | (s)+(m+17) |                                                |

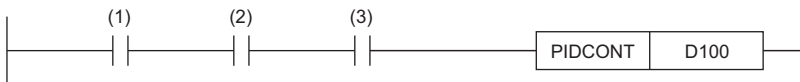
\*1  $m = (n-1) \times 18 + 10$

- The number of device points used for I/O data setting is calculated by the following formula.

Number of device points =  $10 + 18 \times n$  (n: number of loops used)

- Specify each data in binary.
- The initial processing flag sets the processing to be performed at the start of PID operation.
  - Initial operation processing is performed assuming that the sampling cycle that has been set has been reached.
  - If the initial processing flag is 0, PID operations for the number of loops used are performed altogether in a single scan. If it is not 0, PID operations for the number of loops used are divided and processed in several scans, and sampling is started sequentially from the loop that has completed initial processing. The number of processing loops per scan is the number of execution loops per scan that has been set.

- Write data to the I/O data "Write" area by users with the program. Users can read data from the I/O data "Read" area with the program. Never attempt to write data to the area indicated by "Read/write disabled" or "Read"; otherwise, normal operation can no longer be performed. Note that, when starting control from the initial status, the data areas must be cleared by the program.
- Even when the manual manipulated value ( $MV_{MAN}$ ) is output in manual mode, execute the PIDCONT(P) instruction every scan. Unless the PIDCONT(P) instruction is executed, the bumpless function cannot be performed.
- Apply an interlock using the READY signal of each module so that the PIDCONT(P) instruction is executed only when the A/D converter module used to obtain the process value (PV) and the D/A converter module used to output the manipulated value (MV) are normal. If the instruction is executed when these modules are not normal, PID operation cannot be performed normally as the result of failure in normal acquisition of process values (PV) or in normal output of manipulated values (MV).



- (1) Control command  
 (2) READY signal of the A/D converter module  
 (3) READY signal of the D/A converter module

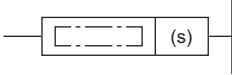
## Operation error

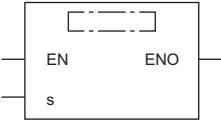
| Error code (SD0) | Description                                                                                  |
|------------------|----------------------------------------------------------------------------------------------|
| 3285H            | The value of the data set in the I/O data area specified by (s) is out of the setting range. |
| 3292H            | The PIDINIT(P) instruction is not executed before the PIDCONT(P) instruction.                |

# Stopping the operation of specified loop number

## PIDSTOP(P)

These instructions stop the PID operation of the loop number in the device specified by (s).

| Ladder                                                                            | ST                                                  |
|-----------------------------------------------------------------------------------|-----------------------------------------------------|
|  | <pre>ENO:=PIDSTOP(EN,s); ENO:=PIDSTOPP(EN,s);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| PIDSTOP     |  |
| PIDSTOPP    |  |

### Setting data

### Description, range, data type

| Operand | Description               | Range   | Data type              | Data type (label) |
|---------|---------------------------|---------|------------------------|-------------------|
| (s)     | Loop number to be stopped | 1 to 32 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition       | —       | Bit                    | BOOL              |
| ENO     | Execution result          | —       | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —      |

### Processing details

- These instructions stop the PID operation of the loop number in the device specified by (s). The loop stopped by the PIDSTOP(P) instruction does not restart PID operation even if the PIDINIT(P) instruction is executed.
- Each instruction holds operation data while the loop is stopped.

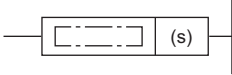
### Operation error

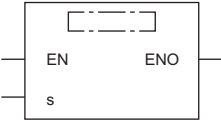
| Error code (SD0) | Description                                                                                                                                                                                              |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | Out-of-range data is set in the device specified by (s). <ul style="list-style-type: none"> <li>The specified loop number does not exist.</li> <li>The specified value is other than 1 to 32.</li> </ul> |
| 3292H            | The PIDINIT(P) and PIDCONT(P) instructions are not executed before the PIDSTOP(P) instruction.                                                                                                           |

# Starting the operation of specified loop number

## PIDRUN(P)

These instructions start the PID operation of the specified loop number.

| Ladder                                                                            | ST                                        |
|-----------------------------------------------------------------------------------|-------------------------------------------|
|  | ENO:=PIDRUN(EN,s);<br>ENO:=PIDRUNP(EN,s); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Execution condition

| Instruction | Execution condition                                                               |
|-------------|-----------------------------------------------------------------------------------|
| PIDRUN      |  |
| PIDRUNP     |  |

### Setting data

### Description, range, data type

| Operand | Description               | Range   | Data type              | Data type (label) |
|---------|---------------------------|---------|------------------------|-------------------|
| (s)     | Loop number to be stopped | 1 to 32 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition       | —       | Bit                    | BOOL              |
| ENO     | Execution result          | —       | Bit                    | BOOL              |

### Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —      |

### Processing details

- These instructions start the PID operation of the loop number in the device specified by (s). These instructions are used to re-execute the PID operation of the loop number that has been stopped by the PIDSTOP(P) instruction.
- The PIDRUN(P) instruction, if executed for a loop number already in progress of PID operation, performs no processing.

### Operation error

| Error code (SD0) | Description                                                                                                                                                                                           |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | Out-of-range data is set in the device specified by (s). <ul style="list-style-type: none"><li>The specified loop number does not exist.</li><li>The specified value is other than 1 to 32.</li></ul> |
| 3292H            | The PIDINIT(P) and PIDCONT(P) instructions are not executed before the PIDRUN(P) instruction.                                                                                                         |

## Changing the parameters of specified loop number

### PIDPRMW(P)

These instructions change the operation parameter of the specified loop number to the PID control data stored in the specified device number and later.

| Ladder | ST                                                          |
|--------|-------------------------------------------------------------|
|        | <pre>ENO:=PIDPRMW(EN,s1,s2); ENO:=PIDPRMWP(EN,s1,s2);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| PIDPRMW     |                     |
| PIDPRMWP    |                     |

### Setting data

### Description, range, data type

| Operand | Description                                                     | Range   | Data type              | Data type (label)   |
|---------|-----------------------------------------------------------------|---------|------------------------|---------------------|
| (s1)    | Loop number to be changed                                       | 1 to 32 | 16-bit unsigned binary | ANY16               |
| (s2)    | Start device where the change-target PID control data is stored | —       | Word                   | ANY16 <sup>*1</sup> |
| EN      | Execution condition                                             | —       | Bit                    | BOOL                |
| ENO     | Execution result                                                | —       | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

- These instructions changes the operation parameter of the loop number in the device specified by (s1) to the PID control data stored in the device number specified by (s2) and later.
- The following figure shows the configuration of the PID control data in the device specified by (s2) and later.

| PID control data |                                                         |
|------------------|---------------------------------------------------------|
| (s2)+0           | Operational expression selection                        |
| (s2)+1           | Sampling period ( $T_S$ )                               |
| (s2)+2           | Proportional constant ( $K_P$ )                         |
| (s2)+3           | Integral constant ( $T_I$ )                             |
| (s2)+4           | Derivative constant ( $T_D$ )                           |
| (s2)+5           | Filter coefficient ( $\alpha$ )                         |
| (s2)+6           | Manipulated value lower limit (MVLL)                    |
| (s2)+7           | Manipulated value upper limit (MVHL)                    |
| (s2)+8           | Manipulated value variation rate limit ( $\Delta MVL$ ) |
| (s2)+9           | Process value variation rate limit ( $\Delta PVL$ )     |

## Operation error

| Error code (SD0) | Description                                                                                                                                          |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3285H            | Out-of-range data is set in the device specified by (s1).<br>The specified loop number does not exist.<br>The specified value is other than 1 to 32. |
|                  | The PID control data in the device specified by (s2) is out of the setting range.                                                                    |
| 3292H            | The PIDINIT(P) instruction is not executed before the PIDPRMW(P) instruction.                                                                        |

# 25 HIGH-SPEED I/O CONTROL INSTRUCTIONS

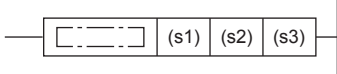
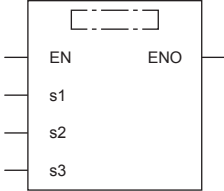
25

## 25.1 Start/Stop of High-Speed I/O

### Start/stop of the 16-bit data high-speed I/O function

#### HIOEN(P)

These instructions control the start and stop operations of a high-speed I/O function.

| Ladder                                                                            | Structured text                                       |
|-----------------------------------------------------------------------------------|-------------------------------------------------------|
|  | ENO:=HIOEN(EN,s1,s2,s3);<br>ENO:=HIOENP(EN,s1,s2,s3); |
| FBD/LD                                                                            |                                                       |
|  |                                                       |

#### Setting data

#### ■Descriptions, ranges, and data types

| Operand | Description                                                      | Range                                                                                                                                         | Data type            | Data type (label) |
|---------|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------|
| (s1)    | Function number to be started or stopped                         | Refer to Function number.<br>(  Page 1078 Function number) | 16-bit signed binary | ANY16             |
| (s2)    | Set the bit of the channel number where the function is started. | -32768 to +32767                                                                                                                              | 16-bit signed binary | ANY16             |
| (s3)    | Set the bit of the channel number where the function is stopped. | -32768 to +32767                                                                                                                              | 16-bit signed binary | ANY16             |
| EN      | Execution condition                                              | —                                                                                                                                             | Bit                  | BOOL              |
| ENO     | Execution result                                                 | —                                                                                                                                             | Bit                  | BOOL              |

#### ■Applicable devices

| Operand | Bit                      | Word                              |                |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|--------------------------|-----------------------------------|----------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB | T, ST, C, D, W, SD, SW, R, ZR, RD | U□\G□, U3E□\G□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s3)    | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

Specify the number of the function to be started or stopped in (s1), the bit of the channel to be started in (s2), and the bit of the channel to be stopped in (s3).

The following table lists the function numbers which can be specified in (s1).

### ■Function number

| Function number   | Function name                                               |
|-------------------|-------------------------------------------------------------|
| K0                | High-speed counter                                          |
| K10 <sup>*1</sup> | Pulse density/rotation speed measurement                    |
| K20 <sup>*1</sup> | High-speed comparison table (controller)                    |
| K21 <sup>*1</sup> | High-speed comparison table (high-speed pulse I/O module 1) |
| K22 <sup>*1</sup> | High-speed comparison table (high-speed pulse I/O module 2) |
| K23 <sup>*1</sup> | High-speed comparison table (high-speed pulse I/O module 3) |
| K24 <sup>*1</sup> | High-speed comparison table (high-speed pulse I/O module 4) |
| K40               | Pulse width measurement                                     |
| K50               | PWM                                                         |

<sup>\*1</sup> When high-speed counter (function number: K0) is stopped during function operation, the function continues to operate, but nothing will be processed.

The following table lists the values which can be specified in (s2) and (s3) for each function number.

- Function number K0

The counting start and stop of a high-speed counter can be controlled for each channel of high-speed counter.

CH1 to CH8 are assigned to controllers, and CH9 to CH16 are assigned to high-speed pulse I/O modules, as shown below.

| Bit position |      |      |      |      |      |      |     |     |     |     |     |     |     |     |     |
|--------------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| b15          | b14  | b13  | b12  | b11  | b10  | b9   | b8  | b7  | b6  | b5  | b4  | b3  | b2  | b1  | b0  |
| CH16         | CH15 | CH14 | CH13 | CH12 | CH11 | CH10 | CH9 | CH8 | CH7 | CH6 | CH5 | CH4 | CH3 | CH2 | CH1 |

#### Ex.

To start CH3, set 04H in (s2). To stop it, set 04H in (s3).

To start CH1, CH4, and CH5, set 19H in (s2). To stop them, set 19H in (s3).

To start CH1 and CH4 and to stop CH5, set 09H in (s2) and set 10H in (s3).

- Function number K10

The measuring start and stop of the pulse density (rotation speed measurement) can be controlled for each channel of the high-speed counter. Turn off b8 to b15.

| Bit position |     |     |     |     |     |    |    |     |     |     |     |     |     |     |     |
|--------------|-----|-----|-----|-----|-----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| b15          | b14 | b13 | b12 | b11 | b10 | b9 | b8 | b7  | b6  | b5  | b4  | b3  | b2  | b1  | b0  |
| —            | —   | —   | —   | —   | —   | —  | —  | CH8 | CH7 | CH6 | CH5 | CH4 | CH3 | CH2 | CH1 |

- Function numbers K20 to K24

Set the value to turn on the bit of the high-speed comparison table number which is to be started or stopped.

For the controller (K20), b0 to b15 can be used.

For the high-speed pulse input/output modules (K21 to K24), b0 to b14 can be used.

| Bit position |      |      |      |      |      |      |     |     |     |     |     |     |     |     |     |
|--------------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| b15          | b14  | b13  | b12  | b11  | b10  | b9   | b8  | b7  | b6  | b5  | b4  | b3  | b2  | b1  | b0  |
| CH16         | CH15 | CH14 | CH13 | CH12 | CH11 | CH10 | CH9 | CH8 | CH7 | CH6 | CH5 | CH4 | CH3 | CH2 | CH1 |

- Function numbers K40 and K50

The measuring start and stop of pulse width measurement and PWM can be controlled for each channel. Ignore unused bits.

CH1 to CH4 are assigned to controllers, and CH5 to CH12 are assigned to high-speed pulse I/O modules, as shown below.

| Bit position |     |     |     |      |      |      |     |     |     |     |     |     |     |     |     |
|--------------|-----|-----|-----|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| b15          | b14 | b13 | b12 | b11  | b10  | b9   | b8  | b7  | b6  | b5  | b4  | b3  | b2  | b1  | b0  |
| —            | —   | —   | —   | CH12 | CH11 | CH10 | CH9 | CH8 | CH7 | CH6 | CH5 | CH4 | CH3 | CH2 | CH1 |



## Precautions

- Do not specify channel numbers of the high-speed pulse input/output module in a program with interrupt priority set to 1.
- When values that turn on the same channel are set for start and stop, the stop operation is prioritized.
- If the high-speed counter (function number: K0) is stopped when the pulse density (function number: K10) or high-speed comparison table (function number: K20 to K24) is executed by the HIOEN instruction, no processing is performed even though the function is in operation.
- If there is a channel where an error occurs (error code: 3781H) when the high-speed counter (function number: K0) is executed by the HIOEN instruction, the counter can no longer be started/stopped for the applicable channel and subsequent channels.
- When using the high-speed comparison table (function number: K20) with the HIOEN instruction, set the number of simultaneous high-speed comparisons (the number of tables specified by the HIOEN instruction + the number of channels for which the high-speed mode of input interrupt signal 1 is selected in the positioning parameter setting) within 32 times.
- When using the high-speed comparison table (function number: K21 to K24) with the HIOEN instruction, set the number of simultaneous high-speed comparisons (the number of tables specified by the HIOEN instruction + the number of channels for which the high-speed mode of input interrupt signal 1 is selected + the number of channels for which OPR (zero signal) is selected in the positioning parameter setting + the number of channels for which OPR (clear signal) is selected in the positioning parameter setting) within 15 times.
- To start the high-speed comparison table (function number: K20 to K24), the high-speed counter must be started using the HIOEN instruction in advance.
- When the high-speed counter (function number: K0) is used, input pulses to the channel to be started after the HIOEN instruction is complete. If pulses are input before the HIOEN instruction is complete, they may be lost.
- The high-speed input/output instructions operate according to the following parameters.

| Function number | Function specified by the HIOEN instruction                 | Parameter setting                                                                     |
|-----------------|-------------------------------------------------------------|---------------------------------------------------------------------------------------|
| K0              | High-speed counter                                          | Channel setting of the high-speed counter                                             |
| K10             | Pulse density (rotation speed measurement)                  | Channel setting of the pulse density/rotation speed measurement<br>High-speed counter |
| K20             | High-speed comparison table (controller)                    | Output setting of the high-speed counter                                              |
| K21             | High-speed comparison table (high-speed pulse I/O module 1) |                                                                                       |
| K22             | High-speed comparison table (high-speed pulse I/O module 2) |                                                                                       |
| K23             | High-speed comparison table (high-speed pulse I/O module 3) |                                                                                       |
| K24             | High-speed comparison table (high-speed pulse I/O module 4) |                                                                                       |
| K40             | Pulse width measurement                                     | Channel setting of the pulse width measurement                                        |
| K50             | PWM                                                         | Channel setting of PWM                                                                |

## Operation error

| Error code (SD0) | Description                                                                                                                                                                    |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1810H            | Channel number which is used in another instruction is specified.                                                                                                              |
| 2801H            | The channel number of a module that does not exist is specified.                                                                                                               |
| 36C5H            | Timeout occurred while communicating with the target modules during execution of the instruction.                                                                              |
| 36C7H            | Signal error was detected while accessing the target modules during execution of the instruction.                                                                              |
| 3285H            | An invalid function number is specified in (s).                                                                                                                                |
| 3600H            | A channel number which is not selected in the parameter setting is executed.                                                                                                   |
| 3602H            | Counting of the high-speed I/O module counter, pulse width measurement, or PWM starts/stops by the HIOEN instruction at interrupt priorities 1 to 16 of the interrupt program. |
| 3781H            | Ring length $\leq$ preset value is specified and executed in channel for which ring length is set and preset input is enabled.                                                 |

# Start/stop of the 32-bit data high-speed I/O function

## DHIOEN(P)

These instructions control the start and stop operations of a high-speed I/O function.

| Ladder | Structured text                                                 |
|--------|-----------------------------------------------------------------|
|        | <pre>ENO:=DHIOEN(EN,s1,s2,s3); ENO:=DHIOENP(EN,s1,s2,s3);</pre> |

| FBD/LD |
|--------|
|        |

## Setting data

### ■Descriptions, ranges, and data types

| Operand | Description                                                      | Range                                                     | Data type            | Data type (label) |
|---------|------------------------------------------------------------------|-----------------------------------------------------------|----------------------|-------------------|
| (s1)    | Function number to be started or stopped                         | Refer to Function number.<br>( Page 1081 Function number) | 16-bit signed binary | ANY16             |
| (s2)    | Set the bit of the channel number where the function is started. | -2147483648 to +2147483647                                | 32-bit signed binary | ANY32             |
| (s3)    | Set the bit of the channel number where the function is stopped. | -2147483648 to +2147483647                                | 32-bit signed binary | ANY32             |
| EN      | Execution condition                                              | —                                                         | Bit                  | BOOL              |
| ENO     | Execution result                                                 | —                                                         | Bit                  | BOOL              |

### ■Applicable devices

| Operand | Bit                      | Word                              |                |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|--------------------------|-----------------------------------|----------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB | T, ST, C, D, W, SD, SW, R, ZR, RD | U□\G□, U3E□\G□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                        | ○                                 | ○              | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s3)    | ○                        | ○                                 | ○              | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |

## Processing details

Specify the number of the function to be started or stopped in (s1), the bit of the channel to be started in (s2), and the bit of the channel to be stopped in (s3).

The following table lists the function numbers which can be specified in (s1).

### ■Function number

| Function number   | Function name                                               |
|-------------------|-------------------------------------------------------------|
| K0                | High-speed counter                                          |
| K10 <sup>*1</sup> | Pulse density/rotation speed measurement                    |
| K20 <sup>*1</sup> | High-speed comparison table (controller)                    |
| K21 <sup>*1</sup> | High-speed comparison table (high-speed pulse I/O module 1) |
| K22 <sup>*1</sup> | High-speed comparison table (high-speed pulse I/O module 2) |
| K23 <sup>*1</sup> | High-speed comparison table (high-speed pulse I/O module 3) |
| K24 <sup>*1</sup> | High-speed comparison table (high-speed pulse I/O module 4) |
| K40               | Pulse width measurement                                     |
| K50               | PWM                                                         |

\*1 When high-speed counter (function number: K0) is stopped during function operation, the function continues to operate, but nothing will be processed.

The following table lists the values which can be specified in (s2) and (s3) for each function number.

- Function number K0

The counting start and stop of a high-speed counter can be controlled for each channel of high-speed counter.

CH1 to CH8 are assigned to controllers, and CH9 to CH16 are assigned to high-speed pulse I/O modules, as shown below.

| Bit position |      |      |      |      |      |      |     |     |     |     |     |     |     |     |     |
|--------------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| b15          | b14  | b13  | b12  | b11  | b10  | b9   | b8  | b7  | b6  | b5  | b4  | b3  | b2  | b1  | b0  |
| CH16         | CH15 | CH14 | CH13 | CH12 | CH11 | CH10 | CH9 | CH8 | CH7 | CH6 | CH5 | CH4 | CH3 | CH2 | CH1 |

#### Ex.

To start CH3, set 04H in (s2). To stop it, set 04H in (s3).

To start CH1, CH4, and CH5, set 19H in (s2). To stop them, set 19H in (s3).

To start CH1 and CH4 and to stop CH5, set 09H in (s2) and set 10H in (s3).

- Function number K10

The measuring start and stop of the pulse density (rotation speed measurement) can be controlled for each channel of the high-speed counter. Turn off b8 to b15.

| Bit position |     |     |     |     |     |    |    |     |     |     |     |     |     |     |     |
|--------------|-----|-----|-----|-----|-----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| b15          | b14 | b13 | b12 | b11 | b10 | b9 | b8 | b7  | b6  | b5  | b4  | b3  | b2  | b1  | b0  |
| —            | —   | —   | —   | —   | —   | —  | —  | CH8 | CH7 | CH6 | CH5 | CH4 | CH3 | CH2 | CH1 |

- Function numbers K20 to K24

Set the value to turn on the bit of the high-speed comparison table number which is to be started or stopped.

For the controller (K20), b0 to b31 can be used.

For the high-speed pulse input/output modules (K21 to K24), b0 to b14 can be used.

| Low-order bit position |      |      |      |      |      |      |     |     |     |     |     |     |     |     |     |
|------------------------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| b15                    | b14  | b13  | b12  | b11  | b10  | b9   | b8  | b7  | b6  | b5  | b4  | b3  | b2  | b1  | b0  |
| CH16                   | CH15 | CH14 | CH13 | CH12 | CH11 | CH10 | CH9 | CH8 | CH7 | CH6 | CH5 | CH4 | CH3 | CH2 | CH1 |

| High-order bit position |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| b31                     | b30  | b29  | b28  | b27  | b26  | b25  | b24  | b23  | b22  | b21  | b20  | b19  | b18  | b17  | b16  |
| CH32                    | CH31 | CH30 | CH29 | CH28 | CH27 | CH26 | CH25 | CH24 | CH23 | CH22 | CH21 | CH20 | CH19 | CH18 | CH17 |

- Function numbers K40 and K50

The measuring start and stop of pulse width measurement and PWM can be controlled for each channel. Ignore unused bits. CH1 to CH4 are assigned to controllers, and CH5 to CH12 are assigned to high-speed pulse I/O modules, as shown below.

| Bit position |     |     |     |      |      |      |     |     |     |     |     |     |     |     |     |
|--------------|-----|-----|-----|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| b15          | b14 | b13 | b12 | b11  | b10  | b9   | b8  | b7  | b6  | b5  | b4  | b3  | b2  | b1  | b0  |
| —            |     |     |     | CH12 | CH11 | CH10 | CH9 | CH8 | CH7 | CH6 | CH5 | CH4 | CH3 | CH2 | CH1 |

## Precautions

- Do not specify channel numbers of the high-speed pulse input/output module in a program with interrupt priority set to "1".
- When values that turn on the same channel are set for start and stop, the stop operation is prioritized.
- If the high-speed counter (function number: K0) is stopped when the pulse density (function number: K10) or high-speed comparison table (function number: K20 to K24) is executed by the HIOEN instruction, no processing is performed even though the function is in operation.
- If there is a channel where an error occurs (error code: 3781H) when the high-speed counter (function number: K0) is executed by the DHIOEN instruction, the counter can no longer be started/stopped for the applicable channel and subsequent channels.
- When using the high-speed comparison table (function number: K20) with the HIOEN instruction, set the number of simultaneous high-speed comparisons (the number of tables specified by the HIOEN instruction + the number of channels for which the high-speed mode of input interrupt signal 1 is selected in the positioning parameter setting) within 32 times.
- When using the high-speed comparison table (function number: K21 to K24) with the HIOEN instruction, set the number of simultaneous high-speed comparisons (the number of tables specified by the HIOEN instruction + the number of channels for which the high-speed mode of input interrupt signal 1 is selected + the number of channels for which OPR (zero signal) is selected in the positioning parameter setting + the number of channels for which OPR (clear signal) is selected in the positioning parameter setting) within 15 times.
- To start the high-speed comparison table (function number: K20 to K24), the high-speed counter must be started using the HIOEN instruction in advance.
- When the high-speed counter (function number: K0) is used, input pulses to the channel to be started after the DHIOEN instruction is complete. If pulses are input before the DHIOEN instruction is complete, they may be lost.
- The high-speed input/output instructions operate according to the following parameters.

| Function number | Function specified by the HIOEN instruction                 | Parameter setting                                                                     |
|-----------------|-------------------------------------------------------------|---------------------------------------------------------------------------------------|
| K0              | High-speed counter                                          | Channel setting of the high-speed counter                                             |
| K10             | Pulse density (rotation speed measurement)                  | Channel setting of the pulse density/rotation speed measurement<br>High-speed counter |
| K20             | High-speed comparison table (controller)                    | Output setting of the high-speed counter                                              |
| K21             | High-speed comparison table (high-speed pulse I/O module 1) |                                                                                       |
| K22             | High-speed comparison table (high-speed pulse I/O module 2) |                                                                                       |
| K23             | High-speed comparison table (high-speed pulse I/O module 3) |                                                                                       |
| K24             | High-speed comparison table (high-speed pulse I/O module 4) |                                                                                       |
| K40             | Pulse width measurement                                     | Channel setting of the pulse width measurement                                        |
| K50             | PWM                                                         | Channel setting of PWM                                                                |

## Operation error

| Error code(SD0) | Description                                                                                                                                                                    |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1810H           | Channel number which is used in another instruction is specified.                                                                                                              |
| 2801H           | The channel number of a module that does not exist is specified.                                                                                                               |
| 36C5H           | Timeout occurred while communicating with the target modules during execution of the instruction.                                                                              |
| 36C7H           | Signal error was detected while accessing the target modules during execution of the instruction.                                                                              |
| 3285H           | An invalid function number is specified in (s).                                                                                                                                |
| 3600H           | A channel number which is not selected in the parameter setting is executed.                                                                                                   |
| 3602H           | Counting of the high-speed I/O module counter, pulse width measurement, or PWM starts/stops by the HIOEN instruction at interrupt priorities 1 to 16 of the interrupt program. |
| 3781H           | Ring length ≤ preset value is specified and executed in channel for which ring length is set and preset input is enabled.                                                      |

## 26.1 Mechanical OPR

The positioning instruction increases and decreases the content of the current address when a forward pulse or reverse pulse is generated.

As the current address is cleared when the controller is powered off, after the power is turned on, the mechanical position and the current address in the controller must be matched. Perform homing using the DSZR/DDSZR instruction for machine OPR to match the mechanical position and the current address in the controller.

### DSZR/DDSZR

This instruction executes mechanical zero return.

- DSZR: Specifies the operand with 16-bit data.
- DDSZR: Specifies the operand with 32-bit data.

| Ladder | Structured text                                                   | FBD/LD |
|--------|-------------------------------------------------------------------|--------|
|        | <pre>ENO:=DSZR(EN,s1,s2,d1,d2); ENO:=DDSZR(EN,s1,s2,d1,d2);</pre> |        |

### Setting data

#### ■Description, range, data type

- DSZR

| Operand | Description                                                             | Range                        | Data type              | Data type (label) |
|---------|-------------------------------------------------------------------------|------------------------------|------------------------|-------------------|
| (s1)    | OPR speed or word device number storing data                            | 1 to 65535<br>(in user unit) | 16-bit unsigned binary | ANY16             |
| (s2)    | Creep speed or word device number storing data                          | 1 to 65535<br>(in user unit) | 16-bit unsigned binary | ANY16             |
| (d1)    | Axis number from which pulses are to be output                          | K1 to K12                    | 16-bit unsigned binary | ANY16             |
| (d2)    | Bit device number of the zero return complete flag or abnormal end flag | —                            | Bit                    | ANYBIT_ARRAY      |
| EN      | Execution condition                                                     | -                            | Bit                    | BOOL              |
| ENO     | Execution result                                                        | -                            | Bit                    | BOOL              |

- DDSZR

| Operand | Description                                                             | Range                             | Data type              | Data type (label) |
|---------|-------------------------------------------------------------------------|-----------------------------------|------------------------|-------------------|
| (s1)    | OPR speed or word device number storing data                            | 1 to 2147483647<br>(in user unit) | 32-bit signed binary   | ANY32             |
| (s2)    | Creep speed or word device number storing data                          | 1 to 2147483647<br>(in user unit) | 32-bit signed binary   | ANY32             |
| (d1)    | Axis number from which pulses are to be output                          | K1 to K12                         | 16-bit unsigned binary | ANY16             |
| (d2)    | Bit device number of the zero return complete flag or abnormal end flag | —                                 | Bit                    | ANYBIT_ARRAY      |
| EN      | Execution condition                                                     | -                                 | Bit                    | BOOL              |
| ENO     | Execution result                                                        | -                                 | Bit                    | BOOL              |

## ■Applicable devices

### • DSZR

| Operand            | Bit                              |      | Word                                  |                 |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|--------------------|----------------------------------|------|---------------------------------------|-----------------|---|-------------|----|------------------------|----------|---|----|------------|
|                    | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□     | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s1)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○ <sup>*4</sup> | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (s2)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○ <sup>*4</sup> | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d1)               | —                                | —    | ○                                     | ○ <sup>*4</sup> | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d2) <sup>*1</sup> | ○ <sup>*2</sup>                  | —    | ○ <sup>*3</sup>                       | —               | — | —           | —  | —                      | —        | — | —  | —          |

### • DDSZR

| Operand            | Bit                              |      | Word                                  |                 |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|--------------------|----------------------------------|------|---------------------------------------|-----------------|---|-------------|----|------------------------|----------|---|----|------------|
|                    | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□     | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s1)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○ <sup>*4</sup> | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |
| (s2)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○ <sup>*4</sup> | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |
| (d1)               | —                                | —    | ○                                     | ○ <sup>*4</sup> | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d2) <sup>*1</sup> | ○ <sup>*2</sup>                  | —    | ○ <sup>*3</sup>                       | —               | — | —           | —  | —                      | —        | — | —  | —          |

\*1 Two devices are occupied from the specified device.

\*2 FX and FY cannot be used.

\*3 T, ST, C, and FD cannot be used.

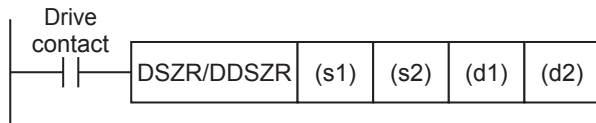
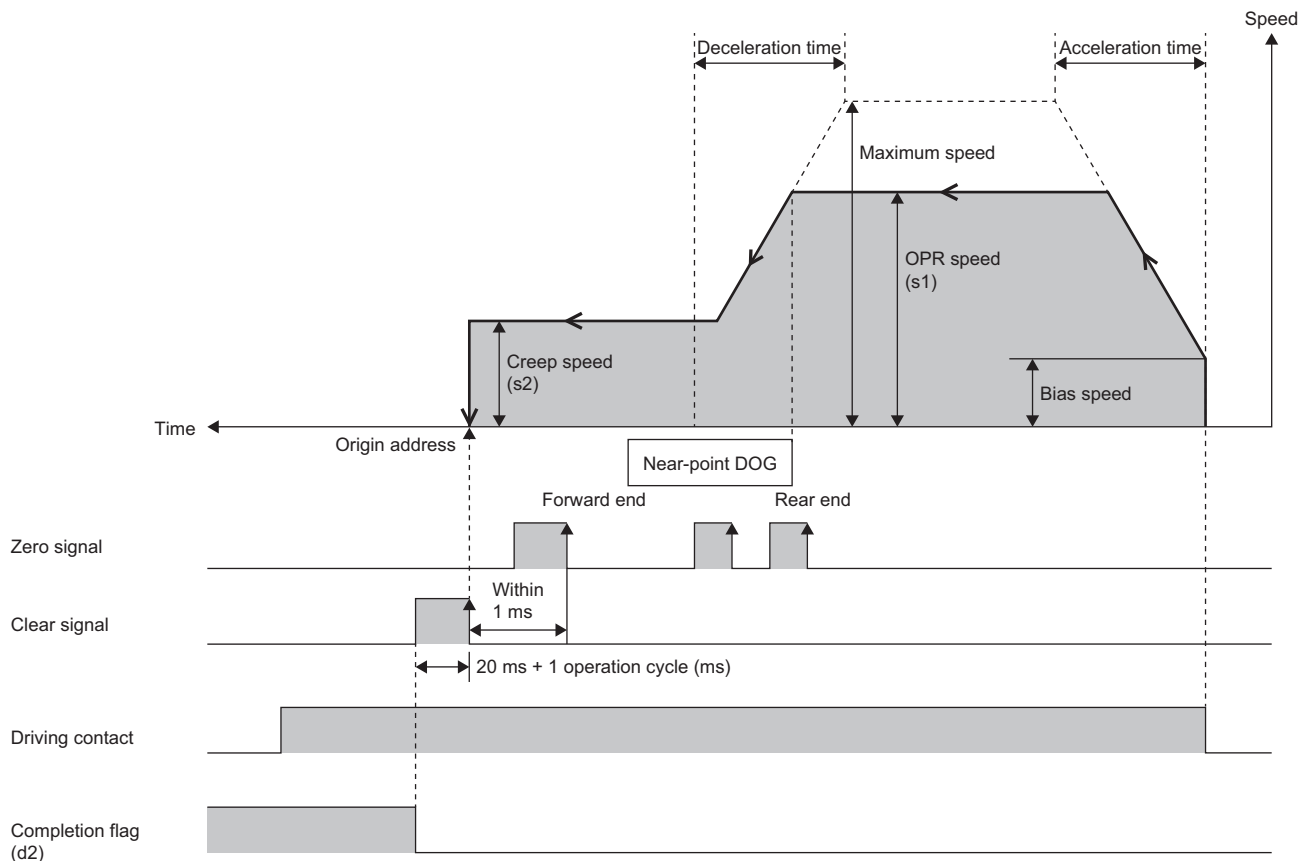
\*4 J□\□ cannot be used.

## Processing details

This instruction executes mechanical zero return.

With the forward limit or reverse limit, zero return with the dog search function can be executed. For details on the dog search function, refer to the following.

 User's manual for the controller used



(1) When the driving contact is turned on, pulses are output and acceleration is performed at the bias speed.

(2) After the OPR speed is reached, the operation will be performed at the OPR speed.

(3) When the near-point dog signal is detected, deceleration is performed.

(4) After the speed has reached the creep speed, the operation will be performed at the creep speed.

(5) When a zero signal is detected after the near-point dog signal is turned on and off, the pulse output is stopped.

- For (s1), specify the OPR speed. Set a value between 1pps and 200kpps using pulse conversion.
- For (s2), specify the creep speed. Set a value between 1pps and 200kpps using pulse conversion.
- For (d1), specify the axis number from which pulses are output. Specify the axis number in which positioning parameters are set in high speed I/O parameters. The operation is not performed if an axis number with no setting is specified.
- Specify the bit device of the instruction execution complete flag for (d2), and specify the bit device of the abnormal end flag for (d2)+1.
- The near-point dog signal and zero-phase signal function follow the device set with parameters. The OPR speed and creep speed specified by the operand overwrite the OPR speed and creep speed of the special register. When the operand is indirectly specified, the special register values are also changed according to the changes in the device values of the operand.

- The pulse output direction is determined by the OPR direction and rotation direction settings. The following shows the operation of when the OPR direction and rotation direction settings are combined.

| Item          |                                                   | Rotation direction setting                             |                                                        |
|---------------|---------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|
|               |                                                   | Current address increase by forward pulse output       | Current address increase by reverse pulse output       |
| OPR direction | Positive direction (address increasing direction) | Output direction: Forward rotation, Address: Increases | Output direction: Reverse rotation, Address: Increases |
|               | Negative direction (address decreasing direction) | Output direction: Reverse rotation, Address: Decreases | Output direction: Forward rotation, Address: Decreases |

- Changes made to the command velocity during positioning operation for the OPR speed (s1) and creep speed (s2) are effective before zero signal detection. Any command velocity changes made after zero signal detection will be reflected when the DSZR/DDSZR instruction is driven again.
- The operation timing of the completion flag is as follows. If a dwell time is specified, the operation is turned on after the dwell time has elapsed.

| Item             | Instruction execution completion flag (d2)                                                                                                                                                                       | Instruction execution abnormal end flag (d2)+1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ON condition     | From the time when homing is completed until the ON→OFF condition is met                                                                                                                                         | From during one of the operations below or the completion of function operation until the ON→OFF condition is met <ul style="list-style-type: none"> <li>• The axis is already used</li> <li>• Drive contact turns off during positioning operation</li> <li>• Pulse output stop command</li> <li>• Pulse deceleration stop command</li> <li>• All outputs disabled (SM9904)</li> <li>• Online change</li> <li>• Home position address error</li> <li>• Deceleration stop when the OPR speed or creep speed is changed to 0</li> <li>• Deceleration stop when the limit is detected after the near-point dog signal is detected</li> </ul> |
| ON→OFF condition | The ON status is held until either one of the following is executed. <ul style="list-style-type: none"> <li>• The user changes to status to OFF.</li> <li>• The positioning instruction is restarted.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



## ■ Related devices

### • Special relays

26

| Controller                           | High-speed pulse I/O module |                  |                  |                  | Name                                 | High-speed I/O Parameter | R/W |
|--------------------------------------|-----------------------------|------------------|------------------|------------------|--------------------------------------|--------------------------|-----|
|                                      | 1st module                  | 2nd module       | 3rd module       | 4th module       |                                      |                          |     |
| Axis 1 to 4                          | Axis 5 and 6                | Axis 7 and 8     | Axis 9 and 10    | Axis 11 and 12   |                                      |                          |     |
| SM5500<br>SM5501<br>SM5502<br>SM5503 | SM5504<br>SM5505            | SM5506<br>SM5507 | SM5508<br>SM5509 | SM5510<br>SM5511 | Positioning instruction activation   | ×                        | R   |
| SM5516<br>SM5517<br>SM5518<br>SM5519 | SM5520<br>SM5521            | SM5522<br>SM5523 | SM5524<br>SM5525 | SM5526<br>SM5527 | Pulse output monitor                 | ×                        | R   |
| SM5532<br>SM5533<br>SM5534<br>SM5535 | SM5536<br>SM5537            | SM5538<br>SM5539 | SM5540<br>SM5541 | SM5542<br>SM5543 | Positioning error occurrence         | ×                        | R/W |
| SM5628<br>SM5629<br>SM5630<br>SM5631 | SM5632<br>SM5633            | SM5634<br>SM5635 | SM5636<br>SM5637 | SM5638<br>SM5639 | Pulse output stop command            | ×                        | R/W |
| SM5644<br>SM5645<br>SM5646<br>SM5647 | SM5648<br>SM5649            | SM5650<br>SM5651 | SM5652<br>SM5653 | SM5654<br>SM5655 | Pulse deceleration stop command      | ×                        | R/W |
| SM5660<br>SM5661<br>SM5662<br>SM5663 | SM5664<br>SM5665            | SM5666<br>SM5667 | SM5668<br>SM5669 | SM5670<br>SM5671 | Forward limit                        | ×                        | R/W |
| SM5676<br>SM5677<br>SM5678<br>SM5679 | SM5680<br>SM5681            | SM5682<br>SM5683 | SM5684<br>SM5685 | SM5686<br>SM5687 | Reverse limit                        | ×                        | R/W |
| SM5772<br>SM5773<br>SM5774<br>SM5775 | SM5776<br>SM5777            | SM5778<br>SM5779 | SM5780<br>SM5781 | SM5782<br>SM5783 | Rotation direction setting           | ○                        | R/W |
| SM5804<br>SM5805<br>SM5806<br>SM5807 | SM5808<br>SM5809            | SM5810<br>SM5811 | SM5812<br>SM5813 | SM5814<br>SM5815 | OPR direction specification          | ○                        | R/W |
| SM5820<br>SM5821<br>SM5822<br>SM5823 | SM5824<br>SM5825            | SM5826<br>SM5827 | SM5828<br>SM5829 | SM5830<br>SM5831 | Clear signal output function enabled | ○                        | R/W |
| SM5868<br>SM5869<br>SM5870<br>SM5871 | SM5872<br>SM5873            | SM5874<br>SM5875 | SM5876<br>SM5877 | SM5878<br>SM5879 | Zero signal count start time         | ○                        | R/W |

R: Read only, R/W: Read or Write, ○: Supported, ×: Not supported

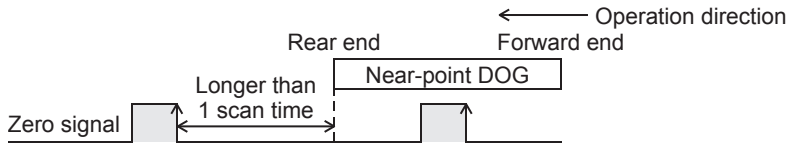
• Special registers

| Controller                                                           | High-speed pulse I/O module        |                                  |                                  |                                  | Name                           | High-speed I/O Parameter | R/W |
|----------------------------------------------------------------------|------------------------------------|----------------------------------|----------------------------------|----------------------------------|--------------------------------|--------------------------|-----|
|                                                                      | 1st module                         | 2nd module                       | 3rd module                       | 4th module                       |                                |                          |     |
| Axis 1 to 4                                                          | Axis 5 and 6                       | Axis 7 and 8                     | Axis 9 and 10                    | Axis 11 and 12                   |                                |                          |     |
| SD5500, SD5501<br>SD5540, SD5541<br>SD5580, SD5581<br>SD5620, SD5621 | SD5660, SD5661<br>SD5700, SD5701   | SD5740, SD5741<br>SD5780, SD5781 | SD5820, SD5821<br>SD5860, SD5861 | SD5900, SD5901<br>SD5940, SD5941 | Current address (user unit)    | ×                        | R/W |
| SD5502, SD5503<br>SD5542, SD5543<br>SD5582, SD5583<br>SD5622, SD5623 | SD5662,<br>SD5663SD5702,<br>SD5703 | SD5742, SD5743<br>SD5782, SD5783 | SD5822, SD5823<br>SD5862, SD5863 | SD5902, SD5903<br>SD5942, SD5943 | Current address (pulse unit)   | ×                        | R/W |
| SD5504, SD5505<br>SD5544, SD5545<br>SD5584, SD5585<br>SD5624, SD5625 | SD5664,<br>SD5665SD5704,<br>SD5705 | SD5744, SD5745<br>SD5784, SD5785 | SD5824, SD5825<br>SD5864, SD5865 | SD5904, SD5905<br>SD5944, SD5945 | Current speed (user unit)      | ×                        | R   |
| SD5510<br>SD5550<br>SD5590<br>SD5630                                 | SD5670<br>SD5710                   | SD5750<br>SD5790                 | SD5830<br>SD5870                 | SD5910<br>SD5950                 | Positioning error (error code) | ×                        | R/W |
| SD5516, SD5517<br>SD5556, SD5557<br>SD5596, SD5597<br>SD5636, SD5637 | SD5676, SD5677<br>SD5716, SD5717   | SD5756, SD5757<br>SD5796, SD5797 | SD5836, SD5837<br>SD5876, SD5877 | SD5916, SD5917<br>SD5956, SD5957 | Maximum velocity               | ○                        | R/W |
| SD5518, SD5519<br>SD5558, SD5559<br>SD5598, SD5599<br>SD5638, SD5639 | SD5678, SD5679<br>SD5718, SD5719   | SD5758, SD5759<br>SD5798, SD5799 | SD5838, SD5839<br>SD5878, SD5879 | SD5918, SD5919<br>SD5958, SD5959 | Bias speed                     | ○                        | R/W |
| SD5520<br>SD5560<br>SD5600<br>SD5640                                 | SD5680<br>SD5720                   | SD5760<br>SD5800                 | SD5840<br>SD5880                 | SD5920<br>SD5960                 | Acceleration time              | ○                        | R/W |
| SD5521<br>SD5561<br>SD5601<br>SD5641                                 | SD5681<br>SD5721                   | SD5761<br>SD5801                 | SD5841<br>SD5881                 | SD5921<br>SD5961                 | Deceleration time              | ○                        | R/W |
| SD5526, SD5527<br>SD5566, SD5567<br>SD5606, SD5607<br>SD5646, SD5647 | SD5686, SD5687<br>SD5726, SD5727   | SD5766, SD5767<br>SD5806, SD5807 | SD5846, SD5847<br>SD5886, SD5887 | SD5926, SD5927<br>SD5966, SD5967 | OPR speed                      | ○                        | R/W |
| SD5528, SD5529<br>SD5568, SD5569<br>SD5608, SD5609<br>SD5648, SD5649 | SD5688, SD5689<br>SD5728, SD5729   | SD5768, SD5769<br>SD5808, SD5809 | SD5848, SD5849<br>SD5888, SD5889 | SD5928, SD5929<br>SD5968, SD5969 | Creep speed                    | ○                        | R/W |
| SD5530, SD5531<br>SD5570, SD5571<br>SD5610, SD5611<br>SD5650, SD5651 | SD5690,<br>SD5691SD5730,<br>SD5731 | SD5770, SD5771<br>SD5810, SD5811 | SD5850, SD5851<br>SD5890, SD5891 | SD5930, SD5931<br>SD5970, SD5971 | Home position address          | ○                        | R/W |
| SD5532<br>SD5572<br>SD5612<br>SD5652                                 | SD5692<br>SD5732                   | SD5772<br>SD5812                 | SD5852<br>SD5892                 | SD5932<br>SD5972                 | Homing zero signal number      | ○                        | R/W |
| SD5533<br>SD5573<br>SD5613<br>SD5653                                 | SD5693<br>SD5733                   | SD5773<br>SD5813                 | SD5853<br>SD5893                 | SD5933<br>SD5973                 | Homing dwell time              | ○                        | R/W |

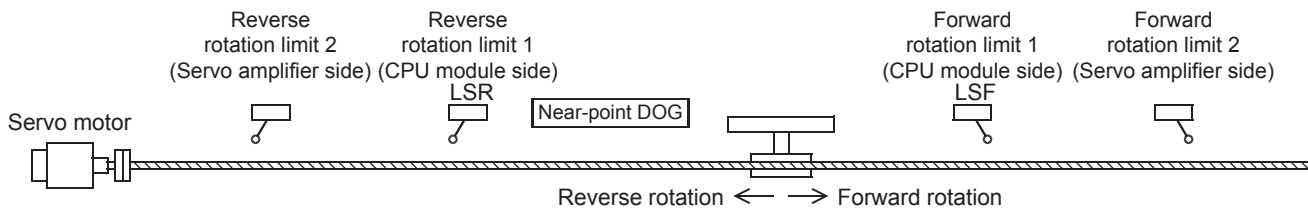
R: Read only, R/W: Read or Write, ○: Supported, ×: Not supported

## Precautions

- The detection of the near-point dog signal (front end/back end) is influenced by the input response time and sequence program operation time. Provide at least one operation cycle between the near-point dog signal back end and the zero signal turning on.
- As the zero signal of the servo motor is used, make adjustments to establish the following relationship for the near-point dog signal back end and the zero signal. If fine adjustment is required for the home position, adjust the position of the near-point dog signal.



- Design the near-point dog signal so that it remains ON long enough to allow the speed to decelerate to the creep speed. Deceleration to achieve the creep speed starts at the front end of the near-point dog signal and stops either at the back end of the near-point dog signal or upon detection of the first zero signal from the back end of the near-point dog signal, after which the current address is cleared. If the creep speed has not been achieved by the time the back end of the near-point dog signal is reached, the stop position will vary.
- Set the near-point dog signal between reverse rotation limit 1 (LSR) and forward rotation limit 1 (LSF). When the near-point dog signal, reverse rotation limit 1 (LSR), and forward rotation limit 1 (LSF) are not in the relationship as shown in the figure below, the intended operation may not be performed.



- Set the creep speed to be sufficiently slow. Deceleration stop is not performed if the creep speed is set too high, which may cause variations in the stop position due to inertia.

## 26.2 Interrupt 1-speed Positioning

In positioning, interrupt 1-speed constant quantity feed is executed by the DVIT/DDVIT instruction.  
This instruction can control interrupt signals by a user program.

### DVIT/DDVIT

This instruction executes interrupt 1-speed constant quantity feed.

- DVIT: Specifies the operand with 16-bit data.
- DDVIT: Specifies the operand with 32-bit data.

| Ladder | Structured text                                                   | FBD/LD |
|--------|-------------------------------------------------------------------|--------|
|        | <pre>ENO:=DVIT(EN,s1,s2,d1,d2); ENO:=DDVIT(EN,s1,s2,d1,d2);</pre> |        |

### Setting data

#### ■Description, range, data type

- DVIT

| Operand | Description                                                                       | Range                              | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------------------|------------------------------------|------------------------|-------------------|
| (s1)    | Positioning address or word device number storing data                            | -32768 to +32767<br>(in user unit) | 16-bit signed binary   | ANY16             |
| (s2)    | Command velocity or word device number storing data                               | 1 to 65535<br>(in user unit)       | 16-bit unsigned binary | ANY16             |
| (d1)    | Axis number from which pulses are to be output                                    | K1 to K12                          | 16-bit unsigned binary | ANY16             |
| (d2)    | Bit device number of the instruction execution complete flag or abnormal end flag | —                                  | Bit                    | ANYBIT_ARRAY      |
| EN      | Execution condition                                                               | -                                  | Bit                    | BOOL              |
| ENO     | Execution result                                                                  | -                                  | Bit                    | BOOL              |

- DDVIT

| Operand | Description                                                                       | Range                                           | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------------------|-------------------------------------------------|------------------------|-------------------|
| (s1)    | Positioning address or word device number storing data                            | -2147483648 to<br>+2147483647<br>(in user unit) | 32-bit signed binary   | ANY32             |
| (s2)    | Command velocity or word device number storing data                               | 1 to 2147483647<br>(in user unit)               | 32-bit signed binary   | ANY32             |
| (d1)    | Axis number from which pulses are to be output                                    | K1 to K12                                       | 16-bit unsigned binary | ANY16             |
| (d2)    | Bit device number of the instruction execution complete flag or abnormal end flag | —                                               | Bit                    | ANYBIT_ARRAY      |
| EN      | Execution condition                                                               | -                                               | Bit                    | BOOL              |
| ENO     | Execution result                                                                  | -                                               | Bit                    | BOOL              |

## ■Applicable devices

### • DVIT

| Operand            | Bit                              |      | Word                                  |                 |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|--------------------|----------------------------------|------|---------------------------------------|-----------------|---|-------------|----|------------------------|----------|---|----|------------|
|                    | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□     | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s1)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○ <sup>*4</sup> | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (s2)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○               | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d1)               | —                                | —    | ○                                     | ○               | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d2) <sup>*1</sup> | ○ <sup>*2</sup>                  | —    | ○ <sup>*3</sup>                       | —               | — | —           | —  | —                      | —        | — | —  | —          |

### • DDVIT

| Operand            | Bit                              |      | Word                                  |                 |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|--------------------|----------------------------------|------|---------------------------------------|-----------------|---|-------------|----|------------------------|----------|---|----|------------|
|                    | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□     | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s1)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○ <sup>*4</sup> | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |
| (s2)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○               | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |
| (d1)               | —                                | —    | ○                                     | ○               | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d2) <sup>*1</sup> | ○ <sup>*2</sup>                  | —    | ○ <sup>*3</sup>                       | —               | — | —           | —  | —                      | —        | — | —  | —          |

\*1 Two devices are occupied from the specified device.

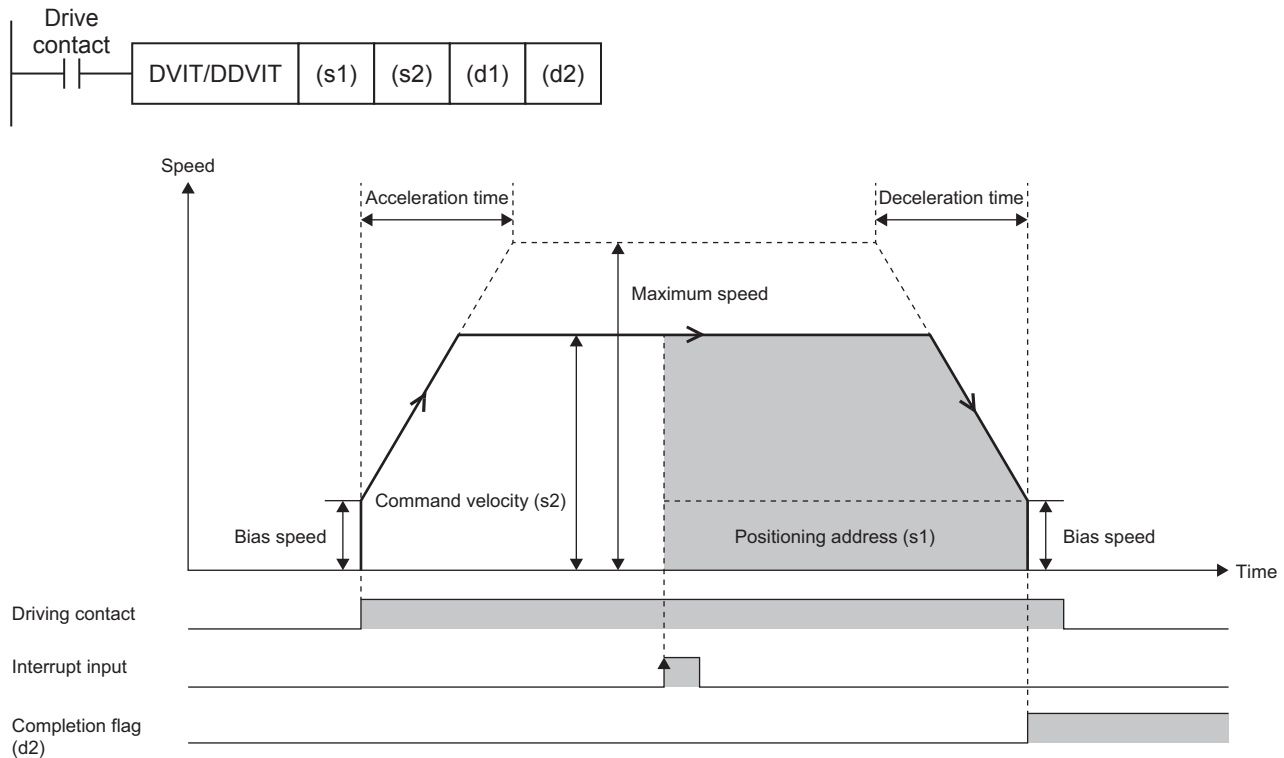
\*2 FX and FY cannot be used.

\*3 T, ST, C, and FD cannot be used.

\*4 J□\□ cannot be used.

## Processing details

This instruction executes interrupt 1-speed constant quantity feed. This instruction moves the operation from the point in which an interrupt input is detected to the specified positioning address at the commanded velocity.



- (1) When the driving contact turns on, movement will occur in the direction of the positioning address specified in (s1) at the command velocity specified in (s2).
- (2) From the point in which interrupt input signal 1 set by the parameter turns on, the pulses for the positioning address specified in (s1) are output before the operation is stopped.

- For (s1), specify the transfer distance that is output after an interrupt, in user units. Set a value between -2147483648 and 2147483647 using pulse number conversion.
- For (s2), specify the velocity in user units. Set a value between 1pps and 200kpps using pulse conversion.
- For (d1), specify the axis number from which pulses are output.
- Specify the bit device of the instruction execution complete flag for (d2), and specify the bit device of the abnormal end flag for (d2)+1.
- When interrupt input signal 1 is detected, the pulses for the positioning address specified in (s1) are output from the point in which interrupt input signal 1 is detected. The operation decelerates and stops in the point that the speed can be reduced.
- When interrupt input signal 1 is disabled, the DVIT/DDVIT instruction cannot be used. When interrupt input signal 1 cannot be detected, pulse output continues at the command velocity of (s2) until interrupt input signal 1 is detected.
- If interrupt input signal 1 was turned on before the instruction is driven, interrupt input signal 1 will not be detected even if the DVIT/DDVIT instruction is driven. However, if both an external start signal and interrupt input signal 1 are on when the external start signal is used, interrupt input signal 1 will be detected at the same time as the DVIT/DDVIT instruction is driven.

- The operation timing of the completion flag is as follows.

| Item             | Instruction execution complete flag (d2)                                                                                                                                                                         | Instruction execution abnormal end flag (d2)+1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ON condition     | From the time when the pulse output of the specified positioning address is completed until the ON→OFF conditions are met                                                                                        | From during one of the operations below or the completion of function operation until the ON→OFF condition is met <ul style="list-style-type: none"> <li>• The axis is already used</li> <li>• Drive contact turns off during positioning operation</li> <li>• Pulse output stop command</li> <li>• Pulse deceleration stop command</li> <li>• Drive direction limit</li> <li>• All outputs disabled (SM9904)</li> <li>• Online change</li> <li>• Positioning address error</li> <li>• Deceleration stop when the command velocity is changed to 0</li> </ul> |
| ON→OFF condition | The ON status is held until either one of the following is executed. <ul style="list-style-type: none"> <li>• The user changes to status to OFF.</li> <li>• The positioning instruction is restarted.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## ■Related devices

- Special relays

| Controller                           | High-speed pulse I/O module |                  |                  |                  | Name                               | High-speed I/O Parameter | R/W |
|--------------------------------------|-----------------------------|------------------|------------------|------------------|------------------------------------|--------------------------|-----|
|                                      | 1st module                  | 2nd module       | 3rd module       | 4th module       |                                    |                          |     |
| Axis 1 to 4                          | Axis 5 and 6                | Axis 7 and 8     | Axis 9 and 10    | Axis 11 and 12   |                                    |                          |     |
| SM5500<br>SM5501<br>SM5502<br>SM5503 | SM5504<br>SM5505            | SM5506<br>SM5507 | SM5508<br>SM5509 | SM5510<br>SM5511 | Positioning instruction activation | ×                        | R   |
| SM5516<br>SM5517<br>SM5518<br>SM5519 | SM5520<br>SM5521            | SM5522<br>SM5523 | SM5524<br>SM5525 | SM5526<br>SM5527 | Pulse output monitor               | ×                        | R   |
| SM5532<br>SM5533<br>SM5534<br>SM5535 | SM5536<br>SM5537            | SM5538<br>SM5539 | SM5540<br>SM5541 | SM5542<br>SM5543 | Positioning error occurrence       | ×                        | R/W |
| SM5628<br>SM5629<br>SM5630<br>SM5631 | SM5632<br>SM5633            | SM5634<br>SM5635 | SM5636<br>SM5637 | SM5638<br>SM5639 | Pulse output stop command          | ×                        | R/W |
| SM5644<br>SM5645<br>SM5646<br>SM5647 | SM5648<br>SM5649            | SM5650<br>SM5651 | SM5652<br>SM5653 | SM5654<br>SM5655 | Pulse deceleration stop command    | ×                        | R/W |
| SM5660<br>SM5661<br>SM5662<br>SM5663 | SM5664<br>SM5665            | SM5666<br>SM5667 | SM5668<br>SM5669 | SM5670<br>SM5671 | Forward limit                      | ×                        | R/W |
| SM5676<br>SM5677<br>SM5678<br>SM5679 | SM5680<br>SM5681            | SM5682<br>SM5683 | SM5684<br>SM5685 | SM5686<br>SM5687 | Reverse limit                      | ×                        | R/W |
| SM5772<br>SM5773<br>SM5774<br>SM5775 | SM5776<br>SM5777            | SM5778<br>SM5779 | SM5780<br>SM5781 | SM5782<br>SM5783 | Rotation direction setting         | ○                        | R/W |

R: Read only, R/W: Read or Write, ○: Supported, ×: Not supported

• Special registers

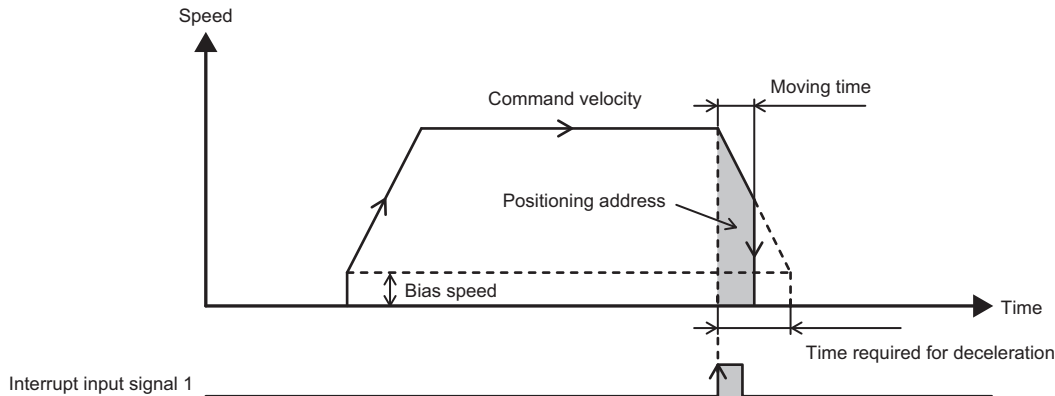
| Controller                                                           | High-speed pulse I/O module        |                                  |                                  |                                  | Name                           | High-speed I/O Parameter | R/W |
|----------------------------------------------------------------------|------------------------------------|----------------------------------|----------------------------------|----------------------------------|--------------------------------|--------------------------|-----|
|                                                                      | 1st module                         | 2nd module                       | 3rd module                       | 4th module                       |                                |                          |     |
| Axis 1 to 4                                                          | Axis 5 and 6                       | Axis 7 and 8                     | Axis 9 and 10                    | Axis 11 and 12                   |                                |                          |     |
| SD5500, SD5501<br>SD5540, SD5541<br>SD5580, SD5581<br>SD5620, SD5621 | SD5660, SD5661<br>SD5700, SD5701   | SD5740, SD5741<br>SD5780, SD5781 | SD5820, SD5821<br>SD5860, SD5861 | SD5900, SD5901<br>SD5940, SD5941 | Current address (user unit)    | ×                        | R/W |
| SD5502, SD5503<br>SD5542, SD5543<br>SD5582, SD5583<br>SD5622, SD5623 | SD5662,<br>SD5663SD5702,<br>SD5703 | SD5742, SD5743<br>SD5782, SD5783 | SD5822, SD5823<br>SD5862, SD5863 | SD5902, SD5903<br>SD5942, SD5943 | Current address (pulse unit)   | ×                        | R/W |
| SD5504, SD5505<br>SD5544, SD5545<br>SD5584, SD5585<br>SD5624, SD5625 | SD5664,<br>SD5665SD5704,<br>SD5705 | SD5744, SD5745<br>SD5784, SD5785 | SD5824, SD5825<br>SD5864, SD5865 | SD5904, SD5905<br>SD5944, SD5945 | Current speed (user unit)      | ×                        | R   |
| SD5510<br>SD5550<br>SD5590<br>SD5630                                 | SD5670<br>SD5710                   | SD5750<br>SD5790                 | SD5830<br>SD5870                 | SD5910<br>SD5950                 | Positioning error (error code) | ×                        | R/W |
| SD5516, SD5517<br>SD5556, SD5557<br>SD5596, SD5597<br>SD5636, SD5637 | SD5676, SD5677<br>SD5716, SD5717   | SD5756, SD5757<br>SD5796, SD5797 | SD5836, SD5837<br>SD5876, SD5877 | SD5916, SD5917<br>SD5956, SD5957 | Maximum velocity               | ○                        | R/W |
| SD5518, SD5519<br>SD5558, SD5559<br>SD5598, SD5599<br>SD5638, SD5639 | SD5678, SD5679<br>SD5718, SD5719   | SD5758, SD5759<br>SD5798, SD5799 | SD5838, SD5839<br>SD5878, SD5879 | SD5918, SD5919<br>SD5958, SD5959 | Bias speed                     | ○                        | R/W |
| SD5520<br>SD5560<br>SD5600<br>SD5640                                 | SD5680<br>SD5720                   | SD5760<br>SD5800                 | SD5840<br>SD5880                 | SD5920<br>SD5960                 | Acceleration time              | ○                        | R/W |
| SD5521<br>SD5561<br>SD5601<br>SD5641                                 | SD5681<br>SD5721                   | SD5761<br>SD5801                 | SD5841<br>SD5881                 | SD5921<br>SD5961                 | Deceleration time              | ○                        | R/W |

R: Read only, R/W: Read or Write, ○: Supported, ×: Not supported



## Precautions

- The operation ends with an error if the positioning address (s1) is 0 at the start of the instruction.
- When the positioning address (s1) is changed to 0 before interrupt input signal 1 is detected, deceleration stop is performed after input interrupt. After the deceleration stop, the positioning operation starts after reversing the output direction to the address that has received the positioning address change and the operation is completed normally.
- When the travel time to move to the positioning address is shorter (the value set in (s1) is smaller) than the time required for the deceleration stop, the movement stops immediately when the positioning address is reached. Note that an immediate stop has a risk of damaging the system, as the motor is stopped without deceleration.



- When interrupt input signal 1 is detected during acceleration, the following operation is performed based on the value of the positioning address (s1).

**1.** Positioning address < Number of pulses required for deceleration from the current velocity

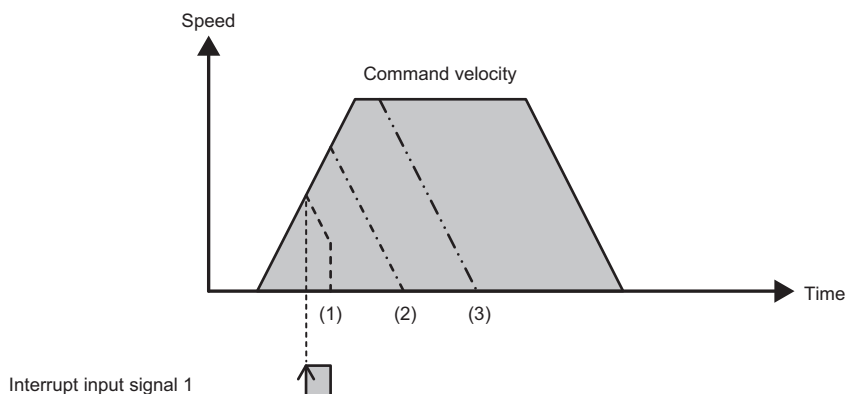
After interrupt input signal 1 turns on, deceleration immediately starts and an immediate stop is performed when the positioning address is reached. Note that an immediate stop has a risk of damaging the system, as the motor is stopped without deceleration.

**2.** Number of pulses required for deceleration from the current velocity  $\leq$  Positioning address < Number of pulses required for acceleration/deceleration from the current velocity

Accelerates to a position where the remaining number of pulses is equal to the number of pulses required for deceleration and then decelerates and stops.

**3.** Number of pulses required for acceleration/deceleration from the current velocity  $\leq$  Positioning address

Accelerates to the command velocity (s2) and then decelerates and stops.



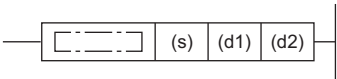
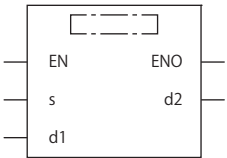
# 26.3 Variable Speed Operation

During positioning, the variable speed operation is performed by the variable speed pulse output instruction. This instruction can perform operations with acceleration/deceleration when the speed is changed.

## PLSV/DPLSV

This instruction outputs variable speed pulses with an assigned rotation direction output.

- PLSV: Specifies the operand with 16-bit data.
- DPLSV: Specifies the operand with 32-bit data.

| Ladder                                                                            | Structured text                                   | FBD/LD                                                                              |
|-----------------------------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------------------------------|
|  | ENO:=PLSV(EN,s,d1,d2);<br>ENO:=DPLSV(EN,s,d1,d2); |  |

## Setting data

### ■Description, range, data type

- PLSV

| Operand | Description                                                                       | Range                              | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------------------|------------------------------------|------------------------|-------------------|
| (s)     | Command velocity or word device number storing data                               | -32768 to +32767<br>(in user unit) | 16-bit signed binary   | ANY16             |
| (d1)    | Axis number from which pulses are to be output                                    | K1 to K12                          | 16-bit unsigned binary | ANY16             |
| (d2)    | Bit device number of the instruction execution complete flag or abnormal end flag | —                                  | Bit                    | ANYBIT_ARRAY      |
| EN      | Execution condition                                                               | -                                  | Bit                    | BOOL              |
| ENO     | Execution result                                                                  | -                                  | Bit                    | BOOL              |

- DPLSV

| Operand | Description                                                                       | Range                                        | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------------------|----------------------------------------------|------------------------|-------------------|
| (s)     | Command velocity or word device number storing data                               | -2147483648 to +2147483647<br>(in user unit) | 32-bit signed binary   | ANY32             |
| (d1)    | Axis number from which pulses are to be output                                    | K1 to K12                                    | 16-bit unsigned binary | ANY16             |
| (d2)    | Bit device number of the instruction execution complete flag or abnormal end flag | —                                            | Bit                    | ANYBIT_ARRAY      |
| EN      | Execution condition                                                               | -                                            | Bit                    | BOOL              |
| ENO     | Execution result                                                                  | -                                            | Bit                    | BOOL              |

## ■Applicable devices

### • PLSV

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s)     | ○*2                              | —   | ○                                     | ○*4        | — | —           | —  | ○                      | ○        | — | —  | —          |
| (d1)    | —                                | —   | ○                                     | ○*4        | — | —           | —  | ○                      | ○        | — | —  | —          |
| (d2)*1  | ○*2                              | —   | ○*3                                   | —          | — | —           | —  | —                      | —        | — | —  | —          |

### • DPLSV

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s)     | ○*2                              | —    | ○                                     | ○*4         | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |
| (d1)    | —                                | —    | ○                                     | ○*4         | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d2)*1  | ○*2                              | —    | ○*3                                   | —           | — | —           | —  | —                      | —        | — | —  | —          |

\*1 Two devices are occupied from the specified device.

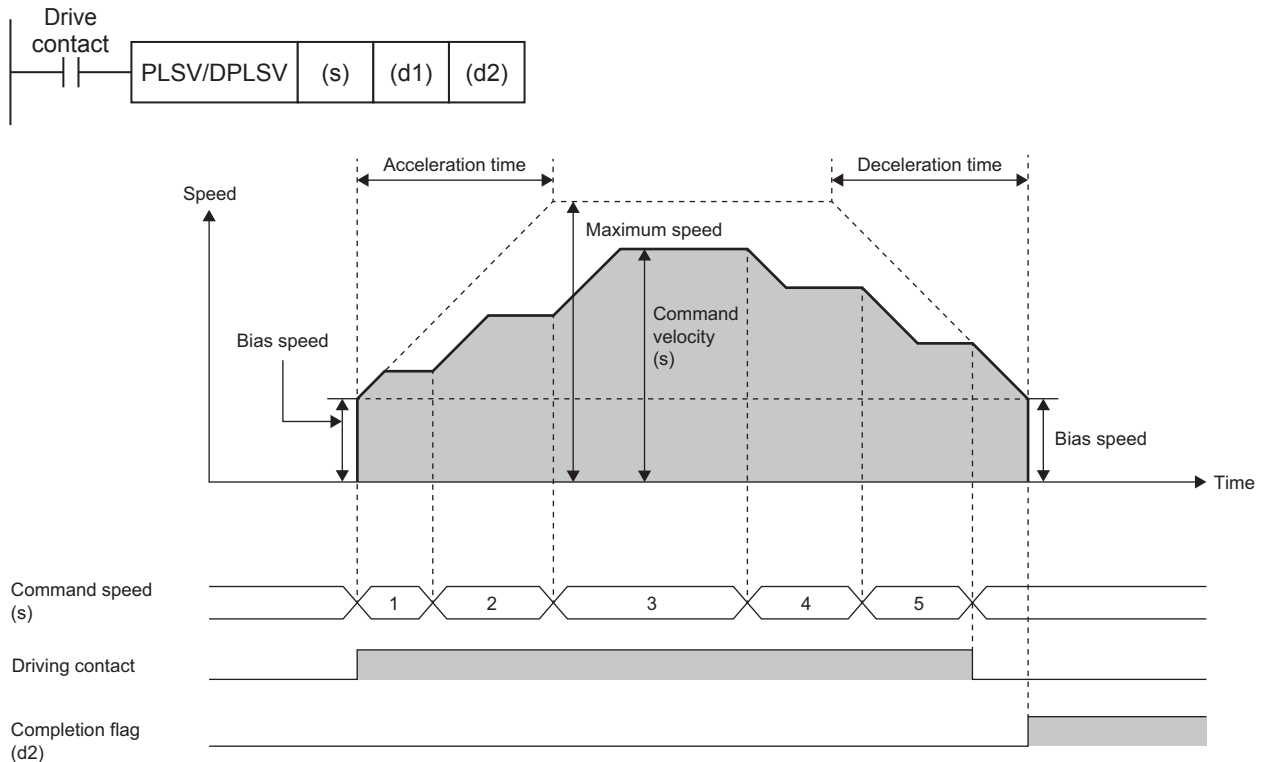
\*2 FX and FY cannot be used.

\*3 T, ST, C, and FD cannot be used.

\*4 J□\□ cannot be used.

## Processing details

This instruction outputs variable speed pulses with an assigned rotation direction output.



- (1) When the driving contact is turned on, pulses are output and acceleration is performed at the bias speed.
  - (2) After the speed has reached the command velocity, the operation will be performed at the command velocity.
  - (3) If the command velocity is changed during operation, an acceleration/deceleration operation is performed and the speed is changed to the specified speed for operation.
  - (4) When the driving contact turns off, a deceleration operation is performed and the pulse output is stopped.
- For (s), specify the command velocity to be output. Set a value between 1pps and 200kpps using pulse conversion.
  - For (d1), specify the axis number from which pulses are output.
  - Specify the bit device of the instruction execution complete flag for (d2), and specify the bit device of the abnormal end flag for (d2)+1.
  - If the command velocity is changed to 0 during operation, the operation decelerates and stops without an abnormal end flag. Note that as long as the drive contact is not turned off, the pulse output will restart when the command velocity is changed.
  - If the command velocity is set to 0 when the instruction is activated, the operation is not performed.
  - When the acceleration time is 0, the speed is immediately changed to the command velocity without any acceleration operation.
  - When the deceleration time is 0, the operation immediately stops when the driving contact turns off without any deceleration operation.
  - The operation timing of the completion flag is as follows.

| Item             | Instruction execution complete flag (d2)                                                                                                                                                                         | Instruction execution abnormal end flag (d2)+1                                                                                                                                                                                                                                                                                                                                                         |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ON condition     | From a deceleration stop by the driving contact turning off or the pulse deceleration stop command until the ON→OFF condition is met                                                                             | From during one of the operations below or the completion of function operation until the ON→OFF condition is met <ul style="list-style-type: none"> <li>• The axis is already used</li> <li>• Pulse output stop command</li> <li>• Drive direction limit</li> <li>• All outputs disabled (SM9904)</li> <li>• Online change</li> <li>• Command velocity at 0 when the instruction is driven</li> </ul> |
| ON→OFF condition | The ON status is held until either one of the following is executed. <ul style="list-style-type: none"> <li>• The user changes to status to OFF.</li> <li>• The positioning instruction is restarted.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                        |

## ■Related devices

- Special relays

| Controller                           | High-speed pulse I/O module |                  |                  |                  | Name                               | High-speed I/O Parameter | R/W |
|--------------------------------------|-----------------------------|------------------|------------------|------------------|------------------------------------|--------------------------|-----|
|                                      | 1st module                  | 2nd module       | 3rd module       | 4th module       |                                    |                          |     |
| Axis 1 to 4                          | Axis 5 and 6                | Axis 7 and 8     | Axis 9 and 10    | Axis 11 and 12   |                                    |                          |     |
| SM5500<br>SM5501<br>SM5502<br>SM5503 | SM5504<br>SM5505            | SM5506<br>SM5507 | SM5508<br>SM5509 | SM5510<br>SM5511 | Positioning instruction activation | ×                        | R   |
| SM5516<br>SM5517<br>SM5518<br>SM5519 | SM5520<br>SM5521            | SM5522<br>SM5523 | SM5524<br>SM5525 | SM5526<br>SM5527 | Pulse output monitor               | ×                        | R   |
| SM5532<br>SM5533<br>SM5534<br>SM5535 | SM5536<br>SM5537            | SM5538<br>SM5539 | SM5540<br>SM5541 | SM5542<br>SM5543 | Positioning error occurrence       | ×                        | R/W |
| SM5628<br>SM5629<br>SM5630<br>SM5631 | SM5632<br>SM5633            | SM5634<br>SM5635 | SM5636<br>SM5637 | SM5638<br>SM5639 | Pulse output stop command          | ×                        | R/W |
| SM5644<br>SM5645<br>SM5646<br>SM5647 | SM5648<br>SM5649            | SM5650<br>SM5651 | SM5652<br>SM5653 | SM5654<br>SM5655 | Pulse deceleration stop command    | ×                        | R/W |
| SM5660<br>SM5661<br>SM5662<br>SM5663 | SM5664<br>SM5665            | SM5666<br>SM5667 | SM5668<br>SM5669 | SM5670<br>SM5671 | Forward limit                      | ×                        | R/W |
| SM5676<br>SM5677<br>SM5678<br>SM5679 | SM5680<br>SM5681            | SM5682<br>SM5683 | SM5684<br>SM5685 | SM5686<br>SM5687 | Reverse limit                      | ×                        | R/W |
| SM5772<br>SM5773<br>SM5774<br>SM5775 | SM5776<br>SM5777            | SM5778<br>SM5779 | SM5780<br>SM5781 | SM5782<br>SM5783 | Rotation direction setting         | ○                        | R/W |

R: Read only, R/W: Read or Write, ○: Supported, ×: Not supported

- Special registers

| Controller                                                           | High-speed pulse I/O module        |                                  |                                  |                                  | Name                           | High-speed I/O Parameter | R/W |
|----------------------------------------------------------------------|------------------------------------|----------------------------------|----------------------------------|----------------------------------|--------------------------------|--------------------------|-----|
|                                                                      | 1st module                         | 2nd module                       | 3rd module                       | 4th module                       |                                |                          |     |
| Axis 1 to 4                                                          | Axis 5 and 6                       | Axis 7 and 8                     | Axis 9 and 10                    | Axis 11 and 12                   |                                |                          |     |
| SD5500, SD5501<br>SD5540, SD5541<br>SD5580, SD5581<br>SD5620, SD5621 | SD5660, SD5661<br>SD5700, SD5701   | SD5740, SD5741<br>SD5780, SD5781 | SD5820, SD5821<br>SD5860, SD5861 | SD5900, SD5901<br>SD5940, SD5941 | Current address (user unit)    | ×                        | R/W |
| SD5502, SD5503<br>SD5542, SD5543<br>SD5582, SD5583<br>SD5622, SD5623 | SD5662,<br>SD5663SD5702,<br>SD5703 | SD5742, SD5743<br>SD5782, SD5783 | SD5822, SD5823<br>SD5862, SD5863 | SD5902, SD5903<br>SD5942, SD5943 | Current address (pulse unit)   | ×                        | R/W |
| SD5504, SD5505<br>SD5544, SD5545<br>SD5584, SD5585<br>SD5624, SD5625 | SD5664,<br>SD5665SD5704,<br>SD5705 | SD5744, SD5745<br>SD5784, SD5785 | SD5824, SD5825<br>SD5864, SD5865 | SD5904, SD5905<br>SD5944, SD5945 | Current speed (user unit)      | ×                        | R   |
| SD5510<br>SD5550<br>SD5590<br>SD5630                                 | SD5670<br>SD5710                   | SD5750<br>SD5790                 | SD5830<br>SD5870                 | SD5910<br>SD5950                 | Positioning error (error code) | ×                        | R/W |
| SD5516, SD5517<br>SD5556, SD5557<br>SD5596, SD5597<br>SD5636, SD5637 | SD5676, SD5677<br>SD5716, SD5717   | SD5756, SD5757<br>SD5796, SD5797 | SD5836, SD5837<br>SD5876, SD5877 | SD5916, SD5917<br>SD5956, SD5957 | Maximum velocity               | ○                        | R/W |
| SD5518, SD5519<br>SD5558, SD5559<br>SD5598, SD5599<br>SD5638, SD5639 | SD5678, SD5679<br>SD5718, SD5719   | SD5758, SD5759<br>SD5798, SD5799 | SD5838, SD5839<br>SD5878, SD5879 | SD5918, SD5919<br>SD5958, SD5959 | Bias speed                     | ○                        | R/W |
| SD5520<br>SD5560<br>SD5600<br>SD5640                                 | SD5680<br>SD5720                   | SD5760<br>SD5800                 | SD5840<br>SD5880                 | SD5920<br>SD5960                 | Acceleration time              | ○                        | R/W |
| SD5521<br>SD5561<br>SD5601<br>SD5641                                 | SD5681<br>SD5721                   | SD5761<br>SD5801                 | SD5841<br>SD5881                 | SD5921<br>SD5961                 | Deceleration time              | ○                        | R/W |

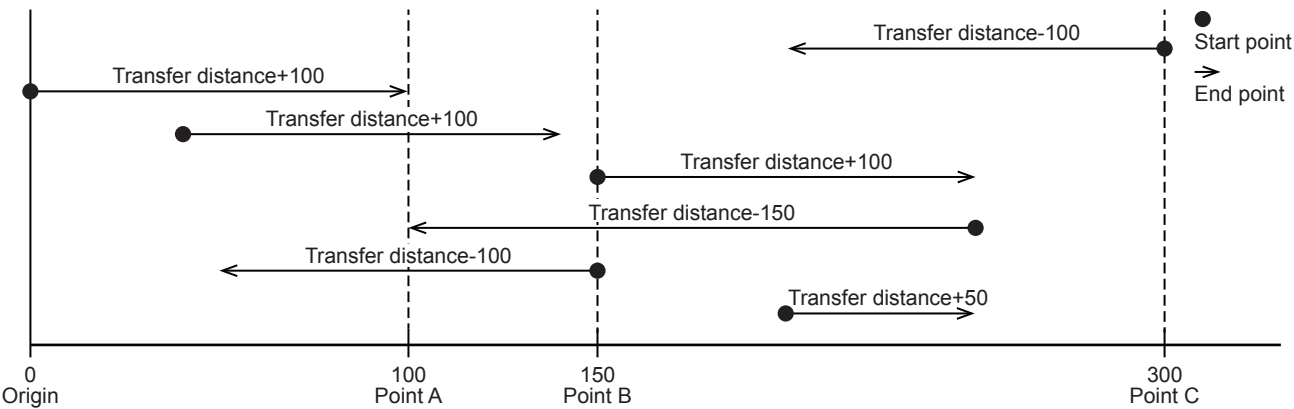
R: Read only, R/W: Read or Write, ○: Supported, ×: Not supported

## Precautions

- If a speed change is made during operation that changes the command velocity sign, an operation to start pulse output from the reverse direction is performed after a deceleration stop. The waiting time from a deceleration stop to re-output is 1ms + scan time. If the motor cannot be stopped within the waiting time, program direction switching so that the command velocity is set to 0, and output is resumed only after ensuring sufficient waiting time following a deceleration stop.
- If the command velocity (s) is 0 when the instruction is started, abnormal completion will occur without performing any operation.

# 26.4 1-speed Positioning (Relative)

This instruction executes 1-speed positioning by the incremental system (position specification by a relative address). The positioning operation is performed after specifying the movement direction and movement amount (relative address) using the current stop position as the start point.



## DRV/DDR

This instruction executes 1-speed positioning with a relative address.

- DRV: Specifies the operand with 16-bit data.
- DDR: Specifies the operand with 32-bit data.

| Ladder | Structured text                                                | FBD/LD |
|--------|----------------------------------------------------------------|--------|
|        | <pre>ENO:=DRV(EN,s1,s2,d1,d2); ENO:=DDR(EN,s1,s2,d1,d2);</pre> |        |

## Setting data

### ■Description, range, data type

#### • DRVI

| Operand | Description                                                             | Range                              | Data type              | Data type (label) |
|---------|-------------------------------------------------------------------------|------------------------------------|------------------------|-------------------|
| (s1)    | Positioning address or word device number storing data                  | -32768 to +32767<br>(in user unit) | 16-bit signed binary   | ANY16             |
| (s2)    | Command velocity or word device number storing data                     | 1 to 65535<br>(in user unit)       | 16-bit unsigned binary | ANY16             |
| (d1)    | Axis number from which pulses are to be output                          | K1 to K12                          | 16-bit unsigned binary | ANY16             |
| (d2)    | Bit device number of the positioning complete flag or abnormal end flag | —                                  | Bit                    | ANYBIT_ARRAY      |
| EN      | Execution condition                                                     | -                                  | Bit                    | BOOL              |
| ENO     | Execution result                                                        | -                                  | Bit                    | BOOL              |

#### • DDRVI

| Operand | Description                                                                       | Range                                        | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------------------|----------------------------------------------|------------------------|-------------------|
| (s1)    | Positioning address or word device number storing data                            | -2147483648 to +2147483647<br>(in user unit) | 32-bit signed binary   | ANY32             |
| (s2)    | Command velocity or word device number storing data                               | 1 to 2147483647<br>(in user unit)            | 32-bit signed binary   | ANY32             |
| (d1)    | Axis number from which pulses are to be output                                    | K1 to K12                                    | 16-bit unsigned binary | ANY16             |
| (d2)    | Bit device number of the instruction execution complete flag or abnormal end flag | —                                            | Bit                    | ANYBIT_ARRAY      |
| EN      | Execution condition                                                               | -                                            | Bit                    | BOOL              |
| ENO     | Execution result                                                                  | -                                            | Bit                    | BOOL              |

### ■Applicable devices

#### • DRVI

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s1)    | ○*2                              | —    | ○                                     | ○*4         | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (s2)    | ○*2                              | —    | ○                                     | ○*4         | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d1)    | —                                | —    | ○                                     | ○*4         | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d2)*1  | ○*2                              | —    | ○*3                                   | —           | — | —           | —  | —                      | —        | — | —  | —          |

#### • DDRVI

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s1)    | ○*2                              | —    | ○                                     | ○*4         | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |
| (s2)    | ○*2                              | —    | ○                                     | ○*4         | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |
| (d1)    | —                                | —    | ○                                     | ○*4         | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d2)*1  | ○*2                              | —    | ○                                     | —           | — | —           | —  | —                      | —        | — | —  | —          |

\*1 Two devices are occupied from the specified device.

\*2 FX and FY cannot be used.

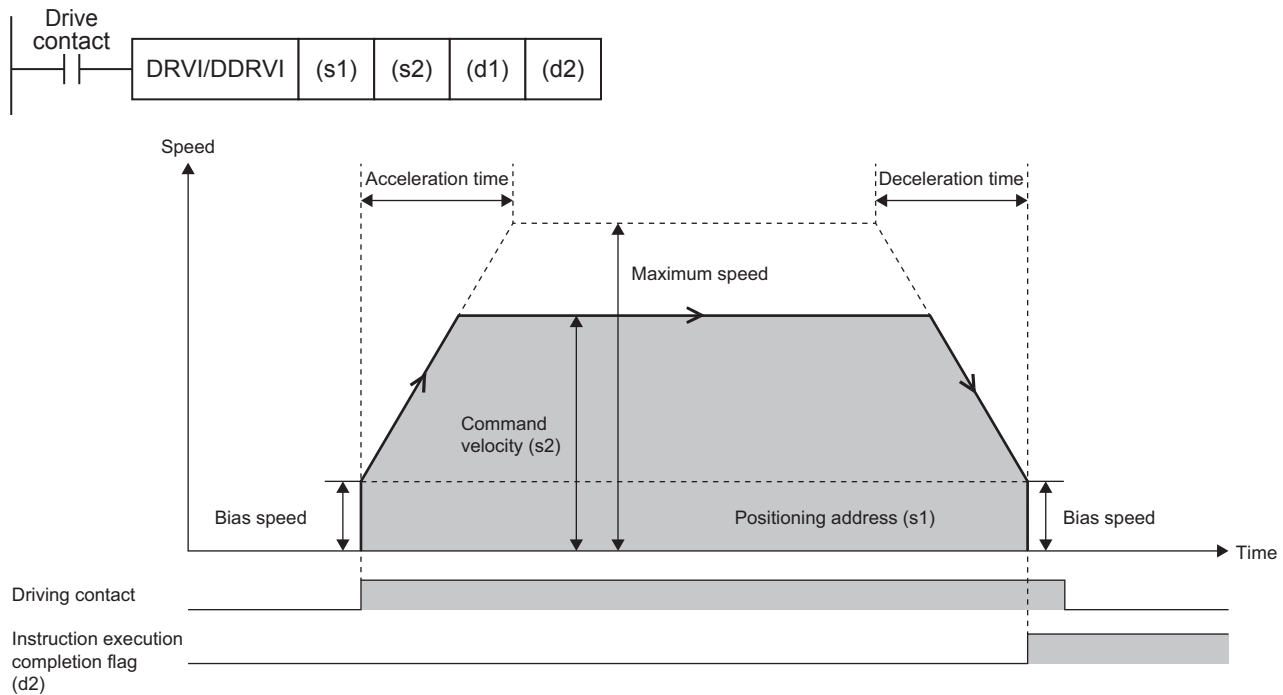
\*3 T, ST, C, and FD cannot be used.

\*4 J□□□ cannot be used.



## Processing details

This instruction executes 1-speed positioning with a relative address. Specify the positioning address in the incremental system, in which the transfer direction and transfer distance from the current position (relative address) are specified for positioning.



- (1) When the driving contact is turned on, pulses are output and acceleration is performed at the bias speed.
- (2) After the speed has reached the command velocity, the operation will be performed at the command velocity.
- (3) Deceleration operation is performed from a point near the target point.
- (4) Pulse output is stopped at the point where the specified positioning address has been moved.

- For (s1), specify the relative positioning address in user units. Set a value between -2147483647 and 2147483647 using pulse number conversion.
- For (s2), specify the command velocity in user units. Set a value between 1pps and 200kpps using pulse conversion.
- For (d1), specify the axis number from which pulses are output.
- Specify the bit device of the instruction execution complete flag for (d2), and specify the bit device of the abnormal end flag for (d2)+1.
- The operation timing of the completion flag is as follows.

| Item             | Instruction execution complete flag (d2)                                                                                                                                                                         | Instruction execution abnormal end flag (d2)+1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ON condition     | From the time when the pulse output of the specified positioning address is completed until the ON→OFF conditions are met                                                                                        | From during one of the operations below or the completion of function operation until the ON→OFF condition is met <ul style="list-style-type: none"> <li>• The axis is already used</li> <li>• Drive contact turns off during positioning operation</li> <li>• Pulse output stop command</li> <li>• Pulse deceleration stop command*1</li> <li>• Drive direction limit</li> <li>• All outputs disabled (SM9904)</li> <li>• Online change</li> <li>• Positioning address error</li> <li>• Deceleration stop when the command velocity is changed to 0</li> </ul> |
| ON→OFF condition | The ON status is held until either one of the following is executed. <ul style="list-style-type: none"> <li>• The user changes to status to OFF.</li> <li>• The positioning instruction is restarted.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

\*1 The abnormal end flag does not turn on when remaining distance operation enabled is turned on.

## ■ Related devices

- Special relays

| Controller                           | High-speed pulse I/O module |                  |                  |                  | Name                                 | High-speed I/O Parameter | R/W |
|--------------------------------------|-----------------------------|------------------|------------------|------------------|--------------------------------------|--------------------------|-----|
|                                      | 1st module                  | 2nd module       | 3rd module       | 4th module       |                                      |                          |     |
| Axis 1 to 4                          | Axis 5 and 6                | Axis 7 and 8     | Axis 9 and 10    | Axis 11 and 12   |                                      |                          |     |
| SM5500<br>SM5501<br>SM5502<br>SM5503 | SM5504<br>SM5505            | SM5506<br>SM5507 | SM5508<br>SM5509 | SM5510<br>SM5511 | Positioning instruction activation   | ×                        | R   |
| SM5516<br>SM5517<br>SM5518<br>SM5519 | SM5520<br>SM5521            | SM5522<br>SM5523 | SM5524<br>SM5525 | SM5526<br>SM5527 | Pulse output monitor                 | ×                        | R   |
| SM5532<br>SM5533<br>SM5534<br>SM5535 | SM5536<br>SM5537            | SM5538<br>SM5539 | SM5540<br>SM5541 | SM5542<br>SM5543 | Positioning error occurrence         | ×                        | R/W |
| SM5596<br>SM5597<br>SM5598<br>SM5599 | SM5600<br>SM5601            | SM5602<br>SM5603 | SM5604<br>SM5605 | SM5606<br>SM5607 | Remaining distance operation enabled | ×                        | R/W |
| SM5612<br>SM5613<br>SM5614<br>SM5615 | SM5616<br>SM5617            | SM5618<br>SM5619 | SM5620<br>SM5621 | SM5622<br>SM5623 | Remaining distance operation start   | ×                        | R/W |
| SM5628<br>SM5629<br>SM5630<br>SM5631 | SM5632<br>SM5633            | SM5634<br>SM5635 | SM5636<br>SM5637 | SM5638<br>SM5639 | Pulse output stop command            | ×                        | R/W |
| SM5644<br>SM5645<br>SM5646<br>SM5647 | SM5648<br>SM5649            | SM5650<br>SM5651 | SM5652<br>SM5653 | SM5654<br>SM5655 | Pulse deceleration stop command      | ×                        | R/W |
| SM5660<br>SM5661<br>SM5662<br>SM5663 | SM5664<br>SM5665            | SM5666<br>SM5667 | SM5668<br>SM5669 | SM5670<br>SM5671 | Forward limit                        | ×                        | R/W |
| SM5676<br>SM5677<br>SM5678<br>SM5679 | SM5680<br>SM5681            | SM5682<br>SM5683 | SM5684<br>SM5685 | SM5686<br>SM5687 | Reverse limit                        | ×                        | R/W |
| SM5772<br>SM5773<br>SM5774<br>SM5775 | SM5776<br>SM5777            | SM5778<br>SM5779 | SM5780<br>SM5781 | SM5782<br>SM5783 | Rotation direction setting           | ○                        | R/W |

R: Read only, R/W: Read or Write, ○: Supported, ×: Not supported

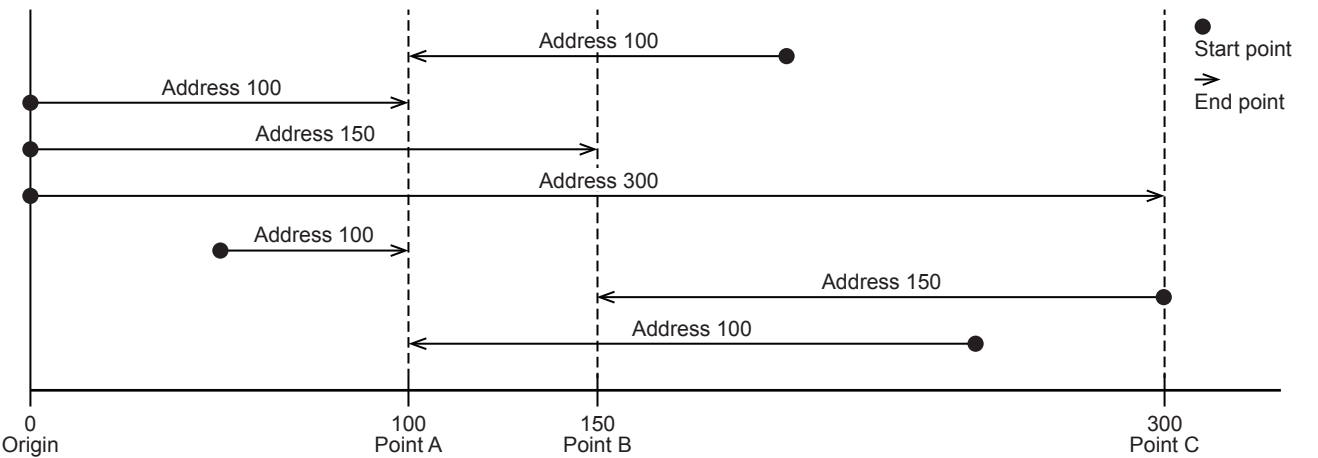
• Special registers

| Controller                                                           | High-speed pulse I/O module        |                                  |                                  |                                  | Name                           | High-speed I/O Parameter | R/W |
|----------------------------------------------------------------------|------------------------------------|----------------------------------|----------------------------------|----------------------------------|--------------------------------|--------------------------|-----|
|                                                                      | 1st module                         | 2nd module                       | 3rd module                       | 4th module                       |                                |                          |     |
| Axis 1 to 4                                                          | Axis 5 and 6                       | Axis 7 and 8                     | Axis 9 and 10                    | Axis 11 and 12                   |                                |                          |     |
| SD5500, SD5501<br>SD5540, SD5541<br>SD5580, SD5581<br>SD5620, SD5621 | SD5660, SD5661<br>SD5700, SD5701   | SD5740, SD5741<br>SD5780, SD5781 | SD5820, SD5821<br>SD5860, SD5861 | SD5900, SD5901<br>SD5940, SD5941 | Current address (user unit)    | ×                        | R/W |
| SD5502, SD5503<br>SD5542, SD5543<br>SD5582, SD5583<br>SD5622, SD5623 | SD5662,<br>SD5663SD5702,<br>SD5703 | SD5742, SD5743<br>SD5782, SD5783 | SD5822, SD5823<br>SD5862, SD5863 | SD5902, SD5903<br>SD5942, SD5943 | Current address (pulse unit)   | ×                        | R/W |
| SD5504, SD5505<br>SD5544, SD5545<br>SD5584, SD5585<br>SD5624, SD5625 | SD5664,<br>SD5665SD5704,<br>SD5705 | SD5744, SD5745<br>SD5784, SD5785 | SD5824, SD5825<br>SD5864, SD5865 | SD5904, SD5905<br>SD5944, SD5945 | Current speed (user unit)      | ×                        | R   |
| SD5510<br>SD5550<br>SD5590<br>SD5630                                 | SD5670<br>SD5710                   | SD5750<br>SD5790                 | SD5830<br>SD5870                 | SD5910<br>SD5950                 | Positioning error (error code) | ×                        | R/W |
| SD5516, SD5517<br>SD5556, SD5557<br>SD5596, SD5597<br>SD5636, SD5637 | SD5676, SD5677<br>SD5716, SD5717   | SD5756, SD5757<br>SD5796, SD5797 | SD5836, SD5837<br>SD5876, SD5877 | SD5916, SD5917<br>SD5956, SD5957 | Maximum velocity               | ○                        | R/W |
| SD5518, SD5519<br>SD5558, SD5559<br>SD5598, SD5599<br>SD5638, SD5639 | SD5678, SD5679<br>SD5718, SD5719   | SD5758, SD5759<br>SD5798, SD5799 | SD5838, SD5839<br>SD5878, SD5879 | SD5918, SD5919<br>SD5958, SD5959 | Bias speed                     | ○                        | R/W |
| SD5520<br>SD5560<br>SD5600<br>SD5640                                 | SD5680<br>SD5720                   | SD5760<br>SD5800                 | SD5840<br>SD5880                 | SD5920<br>SD5960                 | Acceleration time              | ○                        | R/W |
| SD5521<br>SD5561<br>SD5601<br>SD5641                                 | SD5681<br>SD5721                   | SD5761<br>SD5801                 | SD5841<br>SD5881                 | SD5921<br>SD5961                 | Deceleration time              | ○                        | R/W |

R: Read only, R/W: Read or Write, ○: Supported, ×: Not supported

# 26.5 1-speed Positioning (Absolute)

This instruction executes 1-speed positioning by the absolute system (position specification by an absolute address). The positioning operation is performed after specifying the position (absolute address) using the origin as the reference. The start point can be anywhere.



## DRVA/DDRVA

This instruction executes 1-speed positioning with an absolute address.

- DRVA: Specifies the operand with 16-bit data.
- DDRVA: Specifies the operand with 32-bit data.

| Ladder | Structured text                                                   | FBD/LD |
|--------|-------------------------------------------------------------------|--------|
|        | <pre>ENO:=DRVA(EN,s1,s2,d1,d2); ENO:=DDRVA(EN,s1,s2,d1,d2);</pre> |        |

## Setting data

### ■Description, range, data type

#### • DRVA

| Operand | Description                                                                       | Range                              | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------------------|------------------------------------|------------------------|-------------------|
| (s1)    | Positioning address or word device number storing data                            | -32768 to +32767<br>(in user unit) | 16-bit signed binary   | ANY16             |
| (s2)    | Command velocity or word device number storing data                               | 1 to 65535<br>(in user unit)       | 16-bit unsigned binary | ANY16             |
| (d1)    | Axis number from which pulses are to be output                                    | K1 to K12                          | 16-bit unsigned binary | ANY16             |
| (d2)    | Bit device number of the instruction execution complete flag or abnormal end flag | —                                  | Bit                    | ANYBIT_ARRAY      |
| EN      | Execution condition                                                               | -                                  | Bit                    | BOOL              |
| ENO     | Execution result                                                                  | -                                  | Bit                    | BOOL              |

#### • DDRVA

| Operand | Description                                                                       | Range                                        | Data type              | Data type (label) |
|---------|-----------------------------------------------------------------------------------|----------------------------------------------|------------------------|-------------------|
| (s1)    | Positioning address or word device number storing data                            | -2147483648 to +2147483647<br>(in user unit) | 32-bit signed binary   | ANY32             |
| (s2)    | Command velocity or word device number storing data                               | 1 to 2147483647<br>(in user unit)            | 32-bit signed binary   | ANY32             |
| (d1)    | Axis number from which pulses are to be output                                    | K1 to K12                                    | 16-bit unsigned binary | ANY16             |
| (d2)    | Bit device number of the instruction execution complete flag or abnormal end flag | —                                            | Bit                    | ANYBIT_ARRAY      |
| EN      | Execution condition                                                               | -                                            | Bit                    | BOOL              |
| ENO     | Execution result                                                                  | -                                            | Bit                    | BOOL              |

### ■Applicable devices

#### • DRVA

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s1)    | ○*2                              | —    | ○                                     | ○*4         | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (s2)    | ○*2                              | —    | ○                                     | ○*4         | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d1)    | —                                | —    | ○                                     | ○*4         | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d2)*1  | ○*2                              | —    | ○*3                                   | —           | — | —           | —  | —                      | —        | — | —  | —          |

#### • DDRVA

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s1)    | ○*2                              | —    | ○                                     | ○*4         | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |
| (s2)    | ○*2                              | —    | ○                                     | ○*4         | ○ | ○           | ○  | ○                      | ○        | — | —  | —          |
| (d1)    | —                                | —    | ○                                     | ○*4         | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d2)*1  | ○*2                              | —    | ○*3                                   | —           | — | —           | —  | —                      | —        | — | —  | —          |

\*1 Two devices are occupied from the specified device.

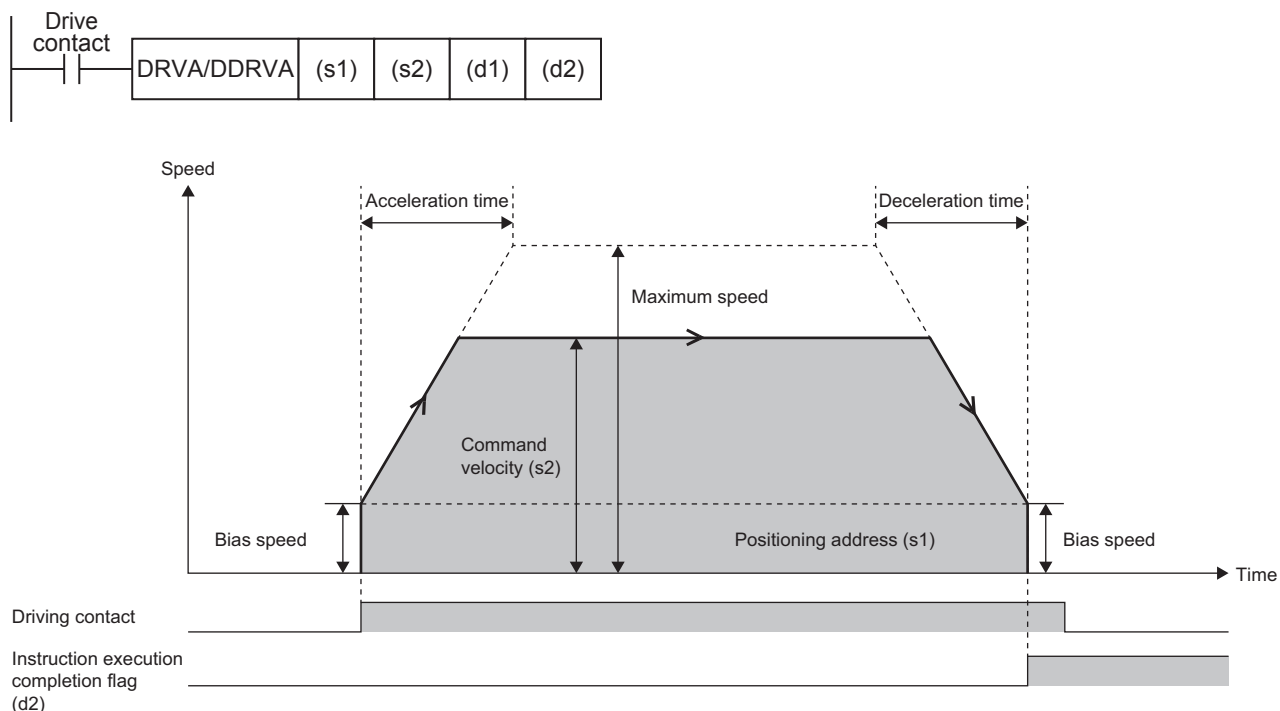
\*2 FX and FY cannot be used.

\*3 T, ST, C, and FD cannot be used.

\*4 J□□□ cannot be used.

## Processing details

This instruction executes 1-speed positioning by absolute address drive. Specify the positioning address in the absolute system, in which the transfer distance from the origin (absolute address) is specified for positioning.



- (1) When the driving contact is turned on, pulses are output and acceleration is performed at the bias speed.
- (2) After the speed has reached the command velocity, the operation will be performed at the command velocity.
- (3) Deceleration operation is performed from a point near the target point.
- (4) Pulse output is stopped at the specified positioning address.

- For (s1), specify the absolute positioning address in user units. Set a value between -2147483647 and 2147483647 using pulse number conversion.
- For (s2), specify the command velocity in user units. Set a value between 1pps and 200kpps using pulse conversion.
- For (d1), specify the axis number from which pulses are output.
- Specify the bit device of the instruction execution complete flag for (d2), and specify the bit device of the abnormal end flag for (d2)+1.
- The operation timing of the completion flag is as follows.

| Item             | Instruction execution complete flag (d2)                                                                                                                                                                         | Instruction execution abnormal end flag (d2)+1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ON condition     | From the time when the pulse output of the specified positioning address is completed until the ON→OFF conditions are met                                                                                        | From during one of the operations below or the completion of function operation until the ON→OFF condition is met <ul style="list-style-type: none"> <li>• The axis is already used</li> <li>• Drive contact turns off during positioning operation</li> <li>• Pulse output stop command</li> <li>• Pulse deceleration stop command*1</li> <li>• Drive direction limit</li> <li>• All outputs disabled (SM9904)</li> <li>• Online change</li> <li>• Positioning address error</li> <li>• Deceleration stop when the command velocity is changed to 0</li> </ul> |
| ON→OFF condition | The ON status is held until either one of the following is executed. <ul style="list-style-type: none"> <li>• The user changes to status to OFF.</li> <li>• The positioning instruction is restarted.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

\*1 The abnormal end flag does not turn on when remaining distance operation enabled is turned on.

## ■ Related devices

- Special relays

| Controller                           | High-speed pulse I/O module |                  |                  |                  | Name                                 | High-speed I/O Parameter | R/W |
|--------------------------------------|-----------------------------|------------------|------------------|------------------|--------------------------------------|--------------------------|-----|
|                                      | 1st module                  | 2nd module       | 3rd module       | 4th module       |                                      |                          |     |
| Axis 1 to 4                          | Axis 5 and 6                | Axis 7 and 8     | Axis 9 and 10    | Axis 11 and 12   |                                      |                          |     |
| SM5500<br>SM5501<br>SM5502<br>SM5503 | SM5504<br>SM5505            | SM5506<br>SM5507 | SM5508<br>SM5509 | SM5510<br>SM5511 | Positioning instruction activation   | ×                        | R   |
| SM5516<br>SM5517<br>SM5518<br>SM5519 | SM5520<br>SM5521            | SM5522<br>SM5523 | SM5524<br>SM5525 | SM5526<br>SM5527 | Pulse output monitor                 | ×                        | R   |
| SM5532<br>SM5533<br>SM5534<br>SM5535 | SM5536<br>SM5537            | SM5538<br>SM5539 | SM5540<br>SM5541 | SM5542<br>SM5543 | Positioning error occurrence         | ×                        | R/W |
| SM5596<br>SM5597<br>SM5598<br>SM5599 | SM5600<br>SM5601            | SM5602<br>SM5603 | SM5604<br>SM5605 | SM5606<br>SM5607 | Remaining distance operation enabled | ×                        | R/W |
| SM5612<br>SM5613<br>SM5614<br>SM5615 | SM5616<br>SM5617            | SM5618<br>SM5619 | SM5620<br>SM5621 | SM5622<br>SM5623 | Remaining distance operation start   | ×                        | R/W |
| SM5628<br>SM5629<br>SM5630<br>SM5631 | SM5632<br>SM5633            | SM5634<br>SM5635 | SM5636<br>SM5637 | SM5638<br>SM5639 | Pulse output stop command            | ×                        | R/W |
| SM5644<br>SM5645<br>SM5646<br>SM5647 | SM5648<br>SM5649            | SM5650<br>SM5651 | SM5652<br>SM5653 | SM5654<br>SM5655 | Pulse deceleration stop command      | ×                        | R/W |
| SM5660<br>SM5661<br>SM5662<br>SM5663 | SM5664<br>SM5665            | SM5666<br>SM5667 | SM5668<br>SM5669 | SM5670<br>SM5671 | Forward limit                        | ×                        | R/W |
| SM5676<br>SM5677<br>SM5678<br>SM5679 | SM5680<br>SM5681            | SM5682<br>SM5683 | SM5684<br>SM5685 | SM5686<br>SM5687 | Reverse limit                        | ×                        | R/W |
| SM5772<br>SM5773<br>SM5774<br>SM5775 | SM5776<br>SM5777            | SM5778<br>SM5779 | SM5780<br>SM5781 | SM5782<br>SM5783 | Rotation direction setting           | ○                        | R/W |

R: Read only, R/W: Read or Write, ○: Supported, ×: Not supported

• Special registers

| Controller                                                           | High-speed pulse I/O module        |                                  |                                  |                                  | Name                           | High-speed I/O Parameter | R/W |
|----------------------------------------------------------------------|------------------------------------|----------------------------------|----------------------------------|----------------------------------|--------------------------------|--------------------------|-----|
|                                                                      | 1st module                         | 2nd module                       | 3rd module                       | 4th module                       |                                |                          |     |
| Axis 1 to 4                                                          | Axis 5 and 6                       | Axis 7 and 8                     | Axis 9 and 10                    | Axis 11 and 12                   |                                |                          |     |
| SD5500, SD5501<br>SD5540, SD5541<br>SD5580, SD5581<br>SD5620, SD5621 | SD5660, SD5661<br>SD5700, SD5701   | SD5740, SD5741<br>SD5780, SD5781 | SD5820, SD5821<br>SD5860, SD5861 | SD5900, SD5901<br>SD5940, SD5941 | Current address (user unit)    | ×                        | R/W |
| SD5502, SD5503<br>SD5542, SD5543<br>SD5582, SD5583<br>SD5622, SD5623 | SD5662,<br>SD5663SD5702,<br>SD5703 | SD5742, SD5743<br>SD5782, SD5783 | SD5822, SD5823<br>SD5862, SD5863 | SD5902, SD5903<br>SD5942, SD5943 | Current address (pulse unit)   | ×                        | R/W |
| SD5504, SD5505<br>SD5544, SD5545<br>SD5584, SD5585<br>SD5624, SD5625 | SD5664,<br>SD5665SD5704,<br>SD5705 | SD5744, SD5745<br>SD5784, SD5785 | SD5824, SD5825<br>SD5864, SD5865 | SD5904, SD5905<br>SD5944, SD5945 | Current speed (user unit)      | ×                        | R   |
| SD5510<br>SD5550<br>SD5590<br>SD5630                                 | SD5670<br>SD5710                   | SD5750<br>SD5790                 | SD5830<br>SD5870                 | SD5910<br>SD5950                 | Positioning error (error code) | ×                        | R/W |
| SD5516, SD5517<br>SD5556, SD5557<br>SD5596, SD5597<br>SD5636, SD5637 | SD5676, SD5677<br>SD5716, SD5717   | SD5756, SD5757<br>SD5796, SD5797 | SD5836, SD5837<br>SD5876, SD5877 | SD5916, SD5917<br>SD5956, SD5957 | Maximum velocity               | ○                        | R/W |
| SD5518, SD5519<br>SD5558, SD5559<br>SD5598, SD5599<br>SD5638, SD5639 | SD5678, SD5679<br>SD5718, SD5719   | SD5758, SD5759<br>SD5798, SD5799 | SD5838, SD5839<br>SD5878, SD5879 | SD5918, SD5919<br>SD5958, SD5959 | Bias speed                     | ○                        | R/W |
| SD5520<br>SD5560<br>SD5600<br>SD5640                                 | SD5680<br>SD5720                   | SD5760<br>SD5800                 | SD5840<br>SD5880                 | SD5920<br>SD5960                 | Acceleration time              | ○                        | R/W |
| SD5521<br>SD5561<br>SD5601<br>SD5641                                 | SD5681<br>SD5721                   | SD5761<br>SD5801                 | SD5841<br>SD5881                 | SD5921<br>SD5961                 | Deceleration time              | ○                        | R/W |

R: Read only, R/W: Read or Write, ○: Supported, ×: Not supported



## 26.6 Table Operation (Multiple Tables)

This instruction executes control method operation set in multiple data tables with the engineering tool.

### DRVTL

This instruction executes continuous operation or stepping operation for multiple tables with one instruction based on the table data set with the engineering tool.

| Ladder | Structured text                           | FBD/LD |
|--------|-------------------------------------------|--------|
|        | <pre>ENO:=DRVTL(EN,n1,n2,n3,d1,d2);</pre> |        |

### Setting data

#### ■Description, range, data type

| Operand | Description                                                                       | Range     | Data type              | Data type (label)                       |
|---------|-----------------------------------------------------------------------------------|-----------|------------------------|-----------------------------------------|
| (d1)    | Axis number from which pulses are to be output                                    | K1 to K12 | 16-bit unsigned binary | ANY16                                   |
| (n1)    | Start table number to be executed                                                 | 1 to 100  | 16-bit unsigned binary | ANY16_U                                 |
| (n2)    | Last table number to be executed                                                  | 1 to 100  | 16-bit unsigned binary | ANY16_U                                 |
| (n3)    | Table execution method                                                            | 0, 1      | 16-bit unsigned binary | ANY16_U                                 |
| (d2)    | Bit device number of the instruction execution complete flag or abnormal end flag | —         | Bit                    | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                               | -         | Bit                    | BOOL                                    |
| ENO     | Execution result                                                                  | -         | Bit                    | BOOL                                    |

#### ■Applicable devices

| Operand            | Bit                              |      | Word                                  |                 |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|--------------------|----------------------------------|------|---------------------------------------|-----------------|---|-------------|----|------------------------|----------|---|----|------------|
|                    | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□□     | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (d1)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○ <sup>*4</sup> | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (n1)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○ <sup>*4</sup> | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (n2)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○ <sup>*4</sup> | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (n3)               | ○ <sup>*2</sup>                  | —    | ○                                     | ○ <sup>*4</sup> | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d2) <sup>*1</sup> | ○ <sup>*2</sup>                  | —    | ○ <sup>*3</sup>                       | —               | — | —           | —  | —                      | —        | — | —  | —          |

\*1 Two devices are occupied from the specified device.

\*2 FX and FY cannot be used.

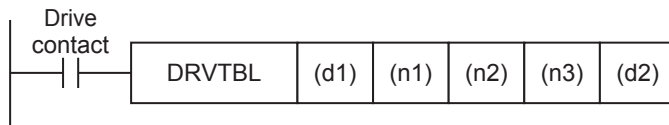
\*3 T, ST, C, and FD cannot be used.

\*4 J□□□ cannot be used.

## Processing details

This instruction can execute continuous operation or stepping operation for multiple tables with one instruction based on the table data set with the engineering tool. For details including the table setting method, refer to the following.

 User's manual for the controller used



- For (d1), specify the axis number from which pulses are output.
- For (n1), specify the start table to be executed according to the output specified in (d1).
- For (n2), specify the last table.
- For (n3), specify the table execution method. Stepping operation is performed when K0 is set, and continuous operation is performed when K1 is set.
- Specify the bit device of the instruction execution complete flag for (d2), and specify the bit device of the abnormal end flag for (d2)+1.
- When (n1) and (n2) are the same, only one table is executed.
- When (n1) is larger than (n2), operation is completed normally after the last table (table 100) is executed.
- When (n3) is set to K0 (stepping operation), operation shifts to the next table if the table shift command is detected when one table is finished. Table shift processing can also be performed using an external start signal.
- The operation timing of the completion flag depends on the table control method.

### ■Related devices

- Special relays

| Controller                           | High-speed pulse I/O module |                  |                  |                  | Name                                          | High-speed I/O Parameter | R/W |
|--------------------------------------|-----------------------------|------------------|------------------|------------------|-----------------------------------------------|--------------------------|-----|
|                                      | 1st module                  | 2nd module       | 3rd module       | 4th module       |                                               |                          |     |
| Axis 1 to 4                          | Axis 5 and 6                | Axis 7 and 8     | Axis 9 and 10    | Axis 11 and 12   |                                               |                          |     |
| SM5580<br>SM5581<br>SM5582<br>SM5583 | SM5584<br>SM5585            | SM5586<br>SM5587 | SM5588<br>SM5589 | SM5590<br>SM5591 | Table shift command                           | ×                        | R/W |
| SM5916<br>SM5917<br>SM5918<br>SM5919 | SM5920<br>SM5921            | SM5922<br>SM5923 | SM5924<br>SM5925 | SM5926<br>SM5927 | Positioning table data initialization disable | ×                        | R/W |

R/W: Read or Write, ×: Not supported

- Special registers

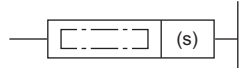
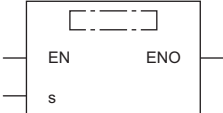
| Controller                           | High-speed pulse I/O module |                  |                  |                  | Name                                           | High-speed I/O Parameter | R/W |
|--------------------------------------|-----------------------------|------------------|------------------|------------------|------------------------------------------------|--------------------------|-----|
|                                      | 1st module                  | 2nd module       | 3rd module       | 4th module       |                                                |                          |     |
| Axis 1 to 4                          | Axis 5 and 6                | Axis 7 and 8     | Axis 9 and 10    | Axis 11 and 12   |                                                |                          |     |
| SD5506<br>SD5546<br>SD5586<br>SD5626 | SD5670<br>SD5706            | SD5746<br>SD5786 | SD5826<br>SD5866 | SD5906<br>SD5946 | Positioning execution table number             | ×                        | R   |
| SD5511<br>SD5551<br>SD5591<br>SD5631 | SD5671<br>SD5711            | SD5751<br>SD5791 | SD5831<br>SD5871 | SD5911<br>SD5951 | Positioning error (error occurrence table No.) | ×                        | R/W |

R: Read only, R/W: Read or Write, ×: Not supported

# 26.7 Interrupt Input 1 Trigger

This instruction generates a trigger equivalent to the input interrupt 1 signal for triggering without using an X device.

## DITRG

| Ladder                                                                            | Structured text   | FBD/LD                                                                              |
|-----------------------------------------------------------------------------------|-------------------|-------------------------------------------------------------------------------------|
|  | ENO:=DITRG(EN,s); |  |

### Setting data

#### ■Description, range, data type

| Operand | Description                                         | Range    | Data type              | Data type (label) |
|---------|-----------------------------------------------------|----------|------------------------|-------------------|
| (s)     | Axis number generating the input interrupt 1 signal | K1 to K4 | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition                                 | -        | Bit                    | BOOL              |
| ENO     | Execution result                                    | -        | Bit                    | BOOL              |

#### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             | Z | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ |   | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s)     | ○*1                              | —    | ○                                     | ○*2         | ○ | —           | —  | ○                      | ○        | — | —  | —          |

\*1 FX and FY cannot be used.

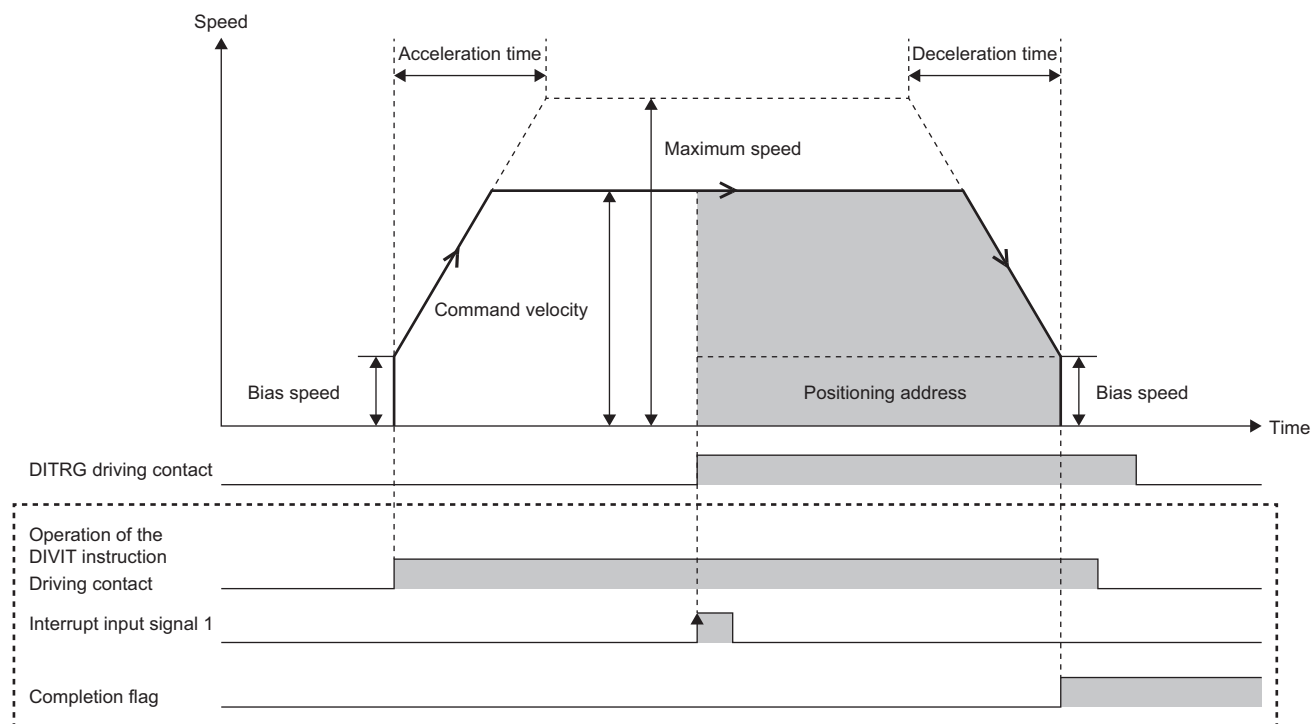
\*2 J□\□ cannot be used.

## Processing details

This instruction generates the input interrupt 1 signal. For (s), specify the axis number by which to output the input interrupt 1 signal.



- Due to its characteristics, this instruction is used in combination with another instruction. The following is an example where this instruction is used in combination with the DVIT instruction.



## Precautions

- To improve the accuracy from command input to trigger start, use this instruction within an interrupt program.
- Since the DITRG instruction operates at the rising edge, when using it within an interrupt program, program it such that the driving contact OFF status can be detected.

### ■Relation to the input interrupt 1 signal

The DITRG instruction and the input interrupt 1 signal operate using the instruction received first as the trigger. Their relationship of operations is shown below.

| Instruction using the input interrupt 1 signal | Trigger                  |                   | Operation                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------|--------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                | Input interrupt 1 signal | DITRG instruction |                                                                                                                                                                                                                                                                                                                          |
| Off                                            | Off                      | Off → On          | No operation                                                                                                                                                                                                                                                                                                             |
| Off                                            | Off → On                 | Off               | No operation                                                                                                                                                                                                                                                                                                             |
| Off                                            | On                       | Off → On          | No operation                                                                                                                                                                                                                                                                                                             |
| Off                                            | Off → On                 | On                | No operation                                                                                                                                                                                                                                                                                                             |
| On                                             | Off                      | Off               | No operation                                                                                                                                                                                                                                                                                                             |
| On                                             | Off                      | Off → On          | The DITRG instruction is used as the trigger.                                                                                                                                                                                                                                                                            |
| Off → On                                       | Off                      | On                | The DITRG instruction trigger is generated immediately after the instruction is executed.                                                                                                                                                                                                                                |
| On                                             | Off → On                 | Off               | The input interrupt 1 signal is used as the trigger.                                                                                                                                                                                                                                                                     |
| Off → On                                       | On                       | Off               | No operation<br>→No processing will be performed even if the input interrupt 1 signal is received before the driving contact for the instruction that uses the input interrupt 1 signal turns on. If the input interrupt 1 signal is turned on or the DITRG instruction is received afterward, it serves as the trigger. |
| On                                             | On                       | Off → On          | No operation<br>→The input interrupt 1 signal is the trigger, and no processing will be performed even if the DITRG instruction is received afterward. Receiving the DITRG instruction will not result in an error.                                                                                                      |
| On                                             | Off → On                 | On                | No operation<br>→The DITRG instruction is the trigger, and no processing will be performed even if the input interrupt 1 signal is received afterward.                                                                                                                                                                   |
| Off → On                                       | On                       | On                | No operation                                                                                                                                                                                                                                                                                                             |

### ■Differences from interrupt input signal 1

The following table lists the differences in specifications between interrupt input signal 1 and the DITRG instruction.

| Items with differences              | Interrupt input signal 1                                                        | DITRG instruction                                                       |
|-------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Parameter: Interrupt input signal 1 | [0: Disable]→The interrupt does not occur.<br>[1: Enable]→The interrupt occurs. | [0: Disable]→The interrupt occurs.<br>[1: Enable]→The interrupt occurs. |
| Operand overwrite                   | Supported                                                                       | Not supported                                                           |

## 26.8 Restoring the Absolute Position

This instruction reads the absolute position (ABS) data of the servo amplifier by connecting to the servo amplifier supporting the absolute position restoration function.

The data is converted into pulse when being read.

### DABRST

| Ladder | Structured text                        | FBD/LD |
|--------|----------------------------------------|--------|
|        | <pre>ENO:=DABRST(EN,s,d1,d2,d3);</pre> |        |

### Setting data

#### ■Description, range, data type

| Operand | Description                                                                                                | Range | Data type            | Data type (label)                       |
|---------|------------------------------------------------------------------------------------------------------------|-------|----------------------|-----------------------------------------|
| (s)     | Head device number that inputs the output signal for absolute position (ABS) data from the servo amplifier | —     | Bit                  | ANYBIT_ARRAY<br>(Number of elements: 3) |
| (d1)    | Head device number that outputs the absolute position (ABS) data control signal to the servo amplifier     | —     | Bit                  | ANYBIT_ARRAY<br>(Number of elements: 3) |
| (d2)    | Device number storing the absolute value (ABS) data (32-bit value)                                         | —     | 32-bit signed binary | ANY32                                   |
| (d3)    | Bit device number of the absolute position (ABS) data reading complete flag or abnormal end flag           | —     | Bit                  | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      | Execution condition                                                                                        | -     | Bit                  | BOOL                                    |
| ENO     | Execution result                                                                                           | -     | Bit                  | BOOL                                    |

#### ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (P) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (s)     | ○*2                              | —    | ○                                     | —           | — | —           | —  | —                      | —        | — | —  | —          |
| (d1)    | ○*2                              | —    | ○                                     | —           | — | —           | —  | —                      | —        | — | —  | —          |
| (d2)    | ○*2                              | —    | ○                                     | ○*4         | ○ | —           | —  | ○                      | ○        | — | —  | —          |
| (d3)*1  | ○*2                              | —    | ○*3                                   | —           | — | —           | —  | —                      | —        | — | —  | —          |

\*1 Two devices are occupied from the specified device.

\*2 FX and FY cannot be used.

\*3 T, ST, C, and FD cannot be used.

\*4 J□\□ cannot be used.

## Processing details

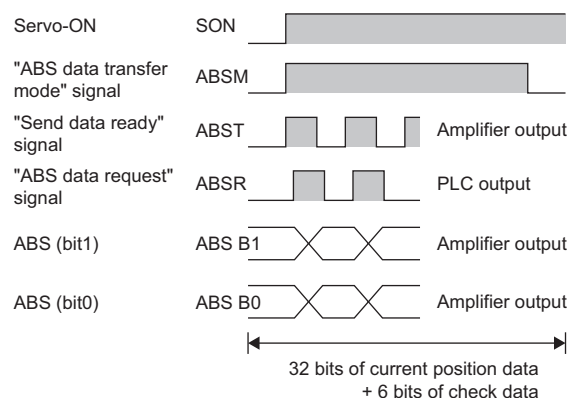
This instruction reads the absolute position (ABS) data by connecting to the servo amplifier. The data is converted into pulse when being read.



- For (s), specify the head device number that inputs the output signal for ABS data from the servo amplifier. Three devices are occupied from (s). Specify ABS(bit0) for (s), ABS(bit1) for (s)+1, and the send data ready signal for (s)+2.
- For (d1), specify the head device number that outputs the ABS data control signal to the servo amplifier. Three devices are occupied from (d1). Specify servo ON for (d1), ABS transfer mode for (d1)+1, and the ABS request signal for (d1)+2.
- For (d2), specify the device that stores the ABS data read from the servo amplifier. Set a value between -2147483647 and 2147483647 using pulse number conversion.
- Specify the bit device of the instruction execution complete flag for (d3), and specify the bit device of the abnormal end flag for (d3)+1.

### ■Absolute position detection operation

1. When the DABRST instruction is driven, the programmable controller drives servo ON output and ABS transfer mode output.
2. While the transmitted data ready signal and the ABS request signal check the send/receive status of each other, 32+6 bit data is communicated.
3. Data is transmitted using two bit lines: ABS bit0 and bit1.
4. When ABS data reading is completed, the execution completed flag operates.

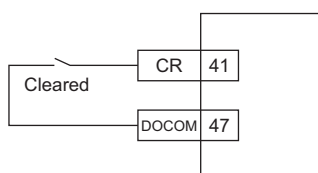


### ■First home seek

Even when a servo motor with the absolute position detection function is used, home seek must be performed at least once when creating a system to send a clear signal to the servo motor.

Perform the first home seek by one of the following procedures.

- Use the DSZR/DDSZR instruction to enable the clear signal function and execute homing.
- Seek the home position of the system by JOG operation or manual position adjustment and input a clear signal to the servo amplifier. To input a clear signal, use the output of the programmable controller or use an external switch as shown in the figure below.



## Precautions

For details on the servo amplifier, refer to the manual for each servo amplifier used.

- Design the system so that the power to the controller and servo amplifier is turned on simultaneously or the servo amplifier is turned on first.
- Keep the driving contact turned on even after the ABS value is read. If the instruction driving contact is turned off after ABS value reading is completed, operation is not performed as the servo ON (SON) signal turns off.
- If the driving contact is turned off during reading, reading is interrupted.
- Even when data cannot be communicated with the servo amplifier, it cannot be detected as an error. Therefore, the status needs to be monitored by the timeout determination timer.
- When using the DABRST instruction, set the rotation direction of the servo motor according to the relationship shown below. Note that, when other settings are configured, the current value controlled by the programmable controller and the sign (positive/negative) in the servo amplifier may not match after the ABS value is read.

| Rotation direction                                     | Servo amplifier settings                                                                                                      |
|--------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Current value increasing with a forward rotation pulse | Forward rotation (CCW) when a forward rotation pulse is input<br>Reverse rotation (CW) when a reverse rotation pulse is input |
| Current value decreasing with a reverse rotation pulse | Reverse rotation (CW) when a forward rotation pulse is input<br>Forward rotation (CCW) when a reverse rotation pulse is input |

## Operation error

| Error code | Description                                                                                     |
|------------|-------------------------------------------------------------------------------------------------|
| 1811H      | 17 or more ABRST instructions were executed at the same time.                                   |
| 1820H      | An online change was performed for a program file in which the ABRST instruction was operating. |
| 2820H      | The device set for the operand of the instruction is out of range.                              |
| 36F0H      | The sum of the ABS data sent from the servo does not match with data in the controller.         |

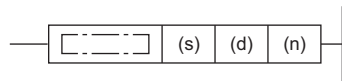


27.1 High-speed IO SM/SD Read/Write (Update)

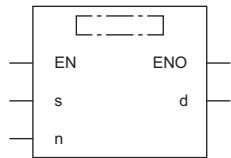
16-bit data read/write (update)

HCMOV(P)

These instructions read and write (update) special relay and special register for high-speed counter, pulse width measurement, PWM, and positioning.

| Ladder                                                                            | Structured text                                 |
|-----------------------------------------------------------------------------------|-------------------------------------------------|
|  | ENO:=HCMOV(EN,s,n,d);<br>ENO:=HCMOVP(EN,s,n,d); |

FBD/LD



## Setting data

### ■Descriptions, ranges, and data types

| Operand | Description                                                                       | Range  | Data type                | Data type (label) |
|---------|-----------------------------------------------------------------------------------|--------|--------------------------|-------------------|
| (s)     | Transfer source device number                                                     | —      | Bit/16-bit signed binary | ANY_ELEMENTARY    |
| (d)     | Transfer destination device number                                                | —      | Bit/16-bit signed binary | ANY_ELEMENTARY    |
| (n)     | Specification to clear the device value of the transfer source after the transfer | K0, K1 | 16-bit unsigned binary   | ANY16_U           |
| EN      | Execution condition                                                               | —      | Bit                      | BOOL              |
| ENO     | Execution result                                                                  | —      | Bit                      | BOOL              |

### ■Applicable devices

| Operand | Bit                      | Word                              |                |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|--------------------------|-----------------------------------|----------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB | T, ST, C, D, W, SD, SW, R, ZR, RD | U□\G□, U3E□\G□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (n)     | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

These instructions transfer the data in the device specified by (s) to the device specified by (d). At this time, if the value of (n) is K0, the value of (s) is not cleared. If the value of (n) is K1, the value of (s) is cleared to "0" after the transfer.

### Point

When (s) is a device supporting high-speed transfer

- When the HCMOV instruction is executed, the latest value is acquired such as the current value of a high-speed counter and transferred to (d).

When (d) is a device supporting high-speed transfer

- When the HCMOV instruction is executed, values such as the current value of a high-speed counter can be changed.

### ■Effect of HCMOV instruction

- By using both input interrupt and HCMOV instruction, the current value of a high-speed counter can be received at the rising edge or falling edge of an external input.
- When HCMOV instruction is used just before a comparison instruction (CMP, ZCP or comparison contact instruction), the latest value of the high-speed counter is used in comparison. The HCMOV instruction can be used repeatedly as there is no limitation to the number of uses.

## Precautions

- When it is necessary to execute comparison and outputting as soon as the current value of a high-speed counter changes, use the high-speed comparison table.
- If 32-bit binary data special device which supports the high-speed transfer (such as the current value of a high-speed counter) is read using the HCMOV instruction, the operation is the same as that when the MOV instruction is used. Updating to the latest value or overwriting the internal register is not possible.
- Do not overwrite the current value of a high-speed counter using the HCMOV instruction while executing the pulse density (rotation speed measurement) or the SPD instruction.
- Transfer is not possible between an SM/SD supporting HCMOV.

### Point

The HCMOV instruction is mainly used to read the current value of the high-speed counter/pulse width measurement and change the current address (in the user units) or the current address (in the pulse unit) of positioning.

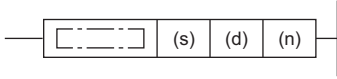
## Operation error

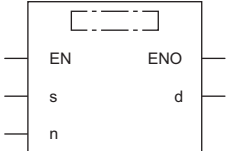
| Error code (SD0) | Description                                                                                                                                                                       |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2801H            | The channel number of a module that does not exist is specified.                                                                                                                  |
| 2821H            | Operands that execute transmission between an SM supporting high-speed transfer and an SD supporting high-speed transfer are specified.                                           |
| 36C5H            | Timeout occurred while communicating with the target modules during execution of the instruction.                                                                                 |
| 36C7H            | Signal error was detected while accessing the target modules during execution of the instruction.                                                                                 |
| 3285H            | A value outside the data range is set in (n).                                                                                                                                     |
| 3602H            | The HCMOV instruction was executed, specifying a device that should not be used as operand for the HCMOV instruction at an interrupt priorities 1 to 16 of the interrupt program. |

## 32-bit data read/write (update)

### DHCMOV(P)

These instructions read and write (update) special relay and special register for high-speed counter, pulse width measurement, PWM, and positioning.

| Ladder                                                                            | Structured text                                   |
|-----------------------------------------------------------------------------------|---------------------------------------------------|
|  | ENO:=DHCMOV(EN,s,n,d);<br>ENO:=DHCMOVP(EN,s,n,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

### Setting data

#### ■Descriptions, ranges, and data types

| Operand | Description                                                                       | Range  | Data type                | Data type (label) |
|---------|-----------------------------------------------------------------------------------|--------|--------------------------|-------------------|
| (s)     | Transfer source device number                                                     | —      | Bit/32-bit signed binary | ANY_ELEMENTARY    |
| (d)     | Transfer destination device number                                                | —      | Bit/32-bit signed binary | ANY_ELEMENTARY    |
| (n)     | Specification to clear the device value of the transfer source after the transfer | K0, K1 | 16-bit unsigned binary   | ANY16_U           |
| EN      | Execution condition                                                               | —      | Bit                      | BOOL              |
| ENO     | Execution result                                                                  | —      | Bit                      | BOOL              |

#### ■Applicable devices

| Operand | Bit                      | Word                              |                |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|--------------------------|-----------------------------------|----------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB | T, ST, C, D, W, SD, SW, R, ZR, RD | U□\G□, U3E□\G□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | ○                        | ○                                 | ○              | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                        | ○                                 | ○              | ○ | ○           | ○  | ○                      | —        | — | —  | —      |
| (n)     | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |

## Processing details

These instructions transfer the data in the device specified by (s) to the device specified by (d). At this time, if the value of (n) is K0, the value of (s) is not cleared. If the value of (n) is K1, the value of (s) is cleared to "0" after the transfer.

### Point

When (s) is a device supporting high-speed transfer

- When the DHCMOV instruction is executed, the latest value is acquired such as the current value of a high-speed counter and transferred to (d).

When (d) is a device supporting high-speed transfer

- When the DHCMOV instruction is executed, values such as the current value of a high-speed counter can be changed.

## Effect of DHCMOV instruction

- By using both input interrupt and DHCMOV instruction, the current value of a high-speed counter can be received at the rising edge or falling edge of an external input.
- When DHCMOV instruction is used just before a comparison instruction (DCMP, DZCP or comparison contact instruction), the latest value of the high-speed counter is used in comparison. The DHCMOV instruction can be used repeatedly as there is no limitation to the number of uses.

## Precautions

- When it is necessary to execute comparison and outputting as soon as the current value of a high-speed counter changes, use the high-speed comparison table.
- Do not overwrite the current value of a high-speed counter using the DHCMOV instruction while executing the pulse density (rotation speed measurement) or the DSPD instruction.
- Do not specify an operand that crosses the boundary of BIN32 bit SD using the DHCMOV instruction. Otherwise, the setting value may become corrupted.
- Transfer is not possible between an SM supporting high-speed transfer and an SD supporting high-speed transfer.
- When setting a value larger than the ring length for the preset value of the high-speed counter SD, if a value is set while the high-speed counter has stopped, an error occurs. However, if a value is set while the high-speed counter is operating, the setting value is reflected without any error.
- When a high-speed counter SD device (current value, maximum value, minimum value) is read out individually, only the read SD device will be updated. Thus, there may be cases when the high-speed counter SD device does not satisfy the relation of minimum value  $\leq$  current value  $\leq$  maximum value temporarily.

### Point

The DHCMOV instruction is mainly used to read the current value of the high-speed counter/pulse width measurement and change the current address (in the user units) or the current address (in the pulse unit) of positioning.

## Operation error

| Error code<br>(SD0/SD8067) | Description                                                                                                                             |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 2801H                      | The channel number of a module that does not exist is specified.                                                                        |
| 2821H                      | Operands that execute transmission between an SM supporting high-speed transfer and an SD supporting high-speed transfer are specified. |
| 36C5H                      | Timeout occurred while communicating with the target modules during execution of the instruction.                                       |
| 36C7H                      | Signal error was detected while accessing the target modules during execution of the instruction.                                       |
| 3285H                      | A value outside the data range is set in (n).                                                                                           |

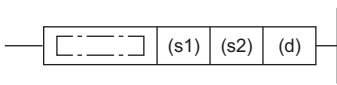
# 28 PULSE RELATED INSTRUCTIONS

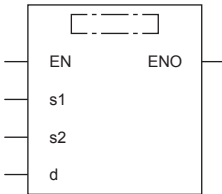
## 28.1 16 Bit Binary/32 Bit Binary Pulse Width Modulation

### 16 bit binary pulse width modulation

#### PWMH

This instruction outputs the pulse (in 16-bit data units) of the ON time (in 16-bit data units) specified by (s1) and the period specified by (s2) to the output destination specified by (d).

| Ladder diagram                                                                    | Structured text        |
|-----------------------------------------------------------------------------------|------------------------|
|  | ENO:=PWMH(EN,s1,s2,d); |

| FBD/LD                                                                             |
|------------------------------------------------------------------------------------|
|  |

#### Setting data

#### ■Descriptions, ranges, and data types

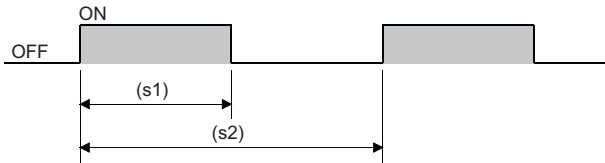
| Operand | Description                                                  | Range      | Data type              | Data type (label) |
|---------|--------------------------------------------------------------|------------|------------------------|-------------------|
| (s1)    | Device number where the ON time (pulse width data) is stored | 1 to 65535 | 16-bit unsigned binary | ANY16             |
| (s2)    | Device number where the cyclic data is stored                | 1 to 65535 | 16-bit unsigned binary | ANY16             |
| (d)     | Channel number from which pulses are to be output            | 1 to 12    | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition                                          | —          | Bit                    | BOOL              |
| ENO     | Execution result                                             | —          | Bit                    | BOOL              |

#### ■Applicable devices

| Operand | Bit                      | Word                              |                |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|--------------------------|-----------------------------------|----------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB | T, ST, C, D, W, SD, SW, R, ZR, RD | U□\G□, U3E□\G□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | ○                        | ○                                 | ○              | ○ | —           | —  | —                      | ○        | — | —  | —      |

## Processing details

- This instruction outputs the pulse of the ON time specified by (s1) and the period specified by (s2) to the output destination specified by (d).



- Time with a unit selected in the parameter setting window ( $\mu\text{s}$  or  $\text{ms}$ ) can be specified by (s1) and (s2).
- The pulse output destination channel number selected in the parameter setting window can be specified by (d).
- This instruction store the number of pulses, pulse width, and period output from each channel to an SD device. The pulse width and period are stored in the units set by the parameters. When 0 is specified in the pulse output, pulses are output without any limitation.

| Pulse output destination channel | Number of output pulses | R/W | Initial value | Timing of reflection on operation                                                                                                                                   | Timing of clearing to initial value |
|----------------------------------|-------------------------|-----|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| CH1                              | SD5301, SD5300          | R/W | 0             | <ul style="list-style-type: none"> <li>When the HCMOV instruction is executed*1</li> <li>When the PWMH instruction is executed</li> <li>END processing</li> </ul>   | STOP/PAUSE→RUN                      |
| CH2                              | SD5317, SD5316          |     |               |                                                                                                                                                                     |                                     |
| CH3                              | SD5333, SD5332          |     |               |                                                                                                                                                                     |                                     |
| CH4                              | SD5349, SD5348          |     |               |                                                                                                                                                                     |                                     |
| CH5                              | SD5364, SD5365          |     |               |                                                                                                                                                                     |                                     |
| CH6                              | SD5380, SD5381          |     |               |                                                                                                                                                                     |                                     |
| CH7                              | SD5396, SD5397          |     |               |                                                                                                                                                                     |                                     |
| CH8                              | SD5412, SD5413          |     |               |                                                                                                                                                                     |                                     |
| CH9                              | SD5428, SD5429          |     |               |                                                                                                                                                                     |                                     |
| CH10                             | SD5444, SD5445          |     |               |                                                                                                                                                                     |                                     |
| CH11                             | SD5460, SD5461          |     |               |                                                                                                                                                                     |                                     |
| CH12                             | SD5476, SD5477          |     |               |                                                                                                                                                                     |                                     |
| Pulse output destination channel | ON time                 | R/W | Initial value | Timing of reflection on operation                                                                                                                                   | Timing of clearing to initial value |
| CH1                              | SD5303, SD5302          | R/W | 0*2           | <ul style="list-style-type: none"> <li>When the HCMOV instruction is executed*1</li> <li>When the PWMH instruction is executed*3</li> <li>END processing</li> </ul> | STOP/PAUSE→RUN                      |
| CH2                              | SD5319, SD5318          |     |               |                                                                                                                                                                     |                                     |
| CH3                              | SD5335, SD5334          |     |               |                                                                                                                                                                     |                                     |
| CH4                              | SD5351, SD5350          |     |               |                                                                                                                                                                     |                                     |
| CH5                              | SD5366, SD5367          |     |               |                                                                                                                                                                     |                                     |
| CH6                              | SD5382, SD5383          |     |               |                                                                                                                                                                     |                                     |
| CH7                              | SD5398, SD5399          |     |               |                                                                                                                                                                     |                                     |
| CH8                              | SD5414, SD5415          |     |               |                                                                                                                                                                     |                                     |
| CH9                              | SD5430, SD5431          |     |               |                                                                                                                                                                     |                                     |
| CH10                             | SD5446, SD5447          |     |               |                                                                                                                                                                     |                                     |
| CH11                             | SD5462, SD5463          |     |               |                                                                                                                                                                     |                                     |
| CH12                             | SD5478, SD5479          |     |               |                                                                                                                                                                     |                                     |

| Pulse output destination channel | Period         | R/W | Initial value   | Timing of reflection on operation                                                                                                                                                         | Timing of clearing to initial value |
|----------------------------------|----------------|-----|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| CH1                              | SD5305, SD5304 | R/W | 0 <sup>*2</sup> | <ul style="list-style-type: none"> <li>When the HCMOV instruction is executed<sup>*1</sup></li> <li>When the PWMH instruction is executed<sup>*3</sup></li> <li>END processing</li> </ul> | STOP/PAUSE→RUN                      |
| CH2                              | SD5321, SD5320 |     |                 |                                                                                                                                                                                           |                                     |
| CH3                              | SD5337, SD5336 |     |                 |                                                                                                                                                                                           |                                     |
| CH4                              | SD5353, SD5352 |     |                 |                                                                                                                                                                                           |                                     |
| CH5                              | SD5368, SD5369 |     |                 |                                                                                                                                                                                           |                                     |
| CH6                              | SD5384, SD5385 |     |                 |                                                                                                                                                                                           |                                     |
| CH7                              | SD5400, SD5401 |     |                 |                                                                                                                                                                                           |                                     |
| CH8                              | SD5416, SD5417 |     |                 |                                                                                                                                                                                           |                                     |
| CH9                              | SD5432, SD5433 |     |                 |                                                                                                                                                                                           |                                     |
| CH10                             | SD5448, SD5449 |     |                 |                                                                                                                                                                                           |                                     |
| CH11                             | SD5464, SD5465 |     |                 |                                                                                                                                                                                           |                                     |
| CH12                             | SD5480, SD5481 |     |                 |                                                                                                                                                                                           |                                     |

\*1 When the DHCMOV instruction is used, the latest value can be read. A writable device can be updated immediately.

\*2 Parameter setting values are set to an SD device at STOP to RUN.

\*3 When this instruction is executed, the pulse width and period specified (s1) and (s2) are set to an SD device.

• After the pulse output is started from each channel, the pulse output monitor turns on.

| Pulse output destination channel | Pulse output monitor | R/W | Initial value | ON timing                                                                                                                               | OFF timing                                                                                                                                                                                          |
|----------------------------------|----------------------|-----|---------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CH1                              | SM5300               | R   | Off           | <ul style="list-style-type: none"> <li>When the HIOEN instruction is executed</li> <li>When the PWMH instruction is executed</li> </ul> | <ul style="list-style-type: none"> <li>Power-on</li> <li>Reset</li> <li>RUN→STOP/PAUSE</li> <li>When the specified number of pulses are output.</li> <li>The drive contact is turned off</li> </ul> |
| CH2                              | SM5301               |     |               |                                                                                                                                         |                                                                                                                                                                                                     |
| CH3                              | SM5302               |     |               |                                                                                                                                         |                                                                                                                                                                                                     |
| CH4                              | SM5303               |     |               |                                                                                                                                         |                                                                                                                                                                                                     |
| CH5                              | SM5304               |     |               |                                                                                                                                         |                                                                                                                                                                                                     |
| CH6                              | SM5305               |     |               |                                                                                                                                         |                                                                                                                                                                                                     |
| CH7                              | SM5306               |     |               |                                                                                                                                         |                                                                                                                                                                                                     |
| CH8                              | SM5307               |     |               |                                                                                                                                         |                                                                                                                                                                                                     |
| CH9                              | SM5308               |     |               |                                                                                                                                         |                                                                                                                                                                                                     |
| CH10                             | SM5309               |     |               |                                                                                                                                         |                                                                                                                                                                                                     |
| CH11                             | SM5310               |     |               |                                                                                                                                         |                                                                                                                                                                                                     |
| CH12                             | SM5311               |     |               |                                                                                                                                         |                                                                                                                                                                                                     |

• This instruction stores the number of pulses output from each channel.

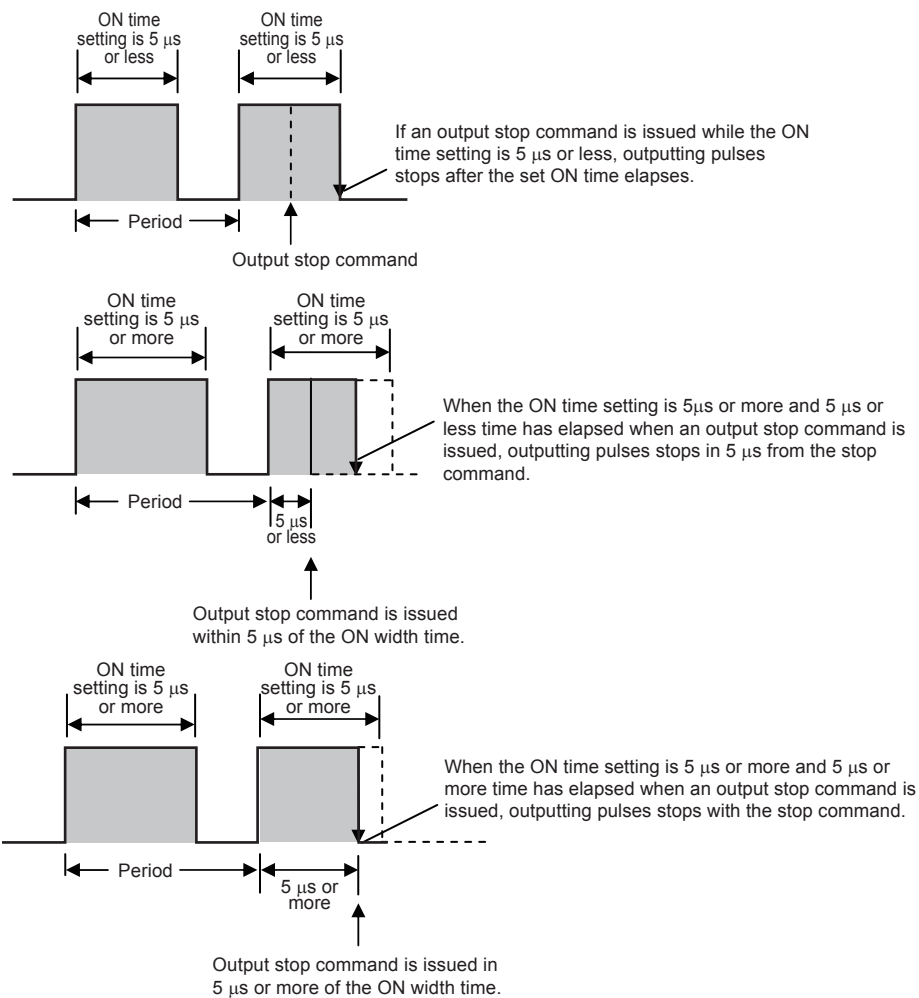
| Pulse output destination channel | Monitoring the current number of output pulses | R/W | Initial value | Timing of reflection on operation                                                                                                                                                                   | Timing of clearing to initial value                                                                 |
|----------------------------------|------------------------------------------------|-----|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| CH1                              | SD5307, SD5306                                 | R/W | 0             | <ul style="list-style-type: none"> <li>When the DHCMOV instruction is executed</li> <li>→ An SD device is updated</li> <li>When the PWMH instruction is executed</li> <li>END processing</li> </ul> | <ul style="list-style-type: none"> <li>Power-on</li> <li>Reset</li> <li>STOP/PAUSE → RUN</li> </ul> |
| CH2                              | SD5323, SD5322                                 |     |               |                                                                                                                                                                                                     |                                                                                                     |
| CH3                              | SD5339, SD5338                                 |     |               |                                                                                                                                                                                                     |                                                                                                     |
| CH4                              | SD5355, SD5354                                 |     |               |                                                                                                                                                                                                     |                                                                                                     |



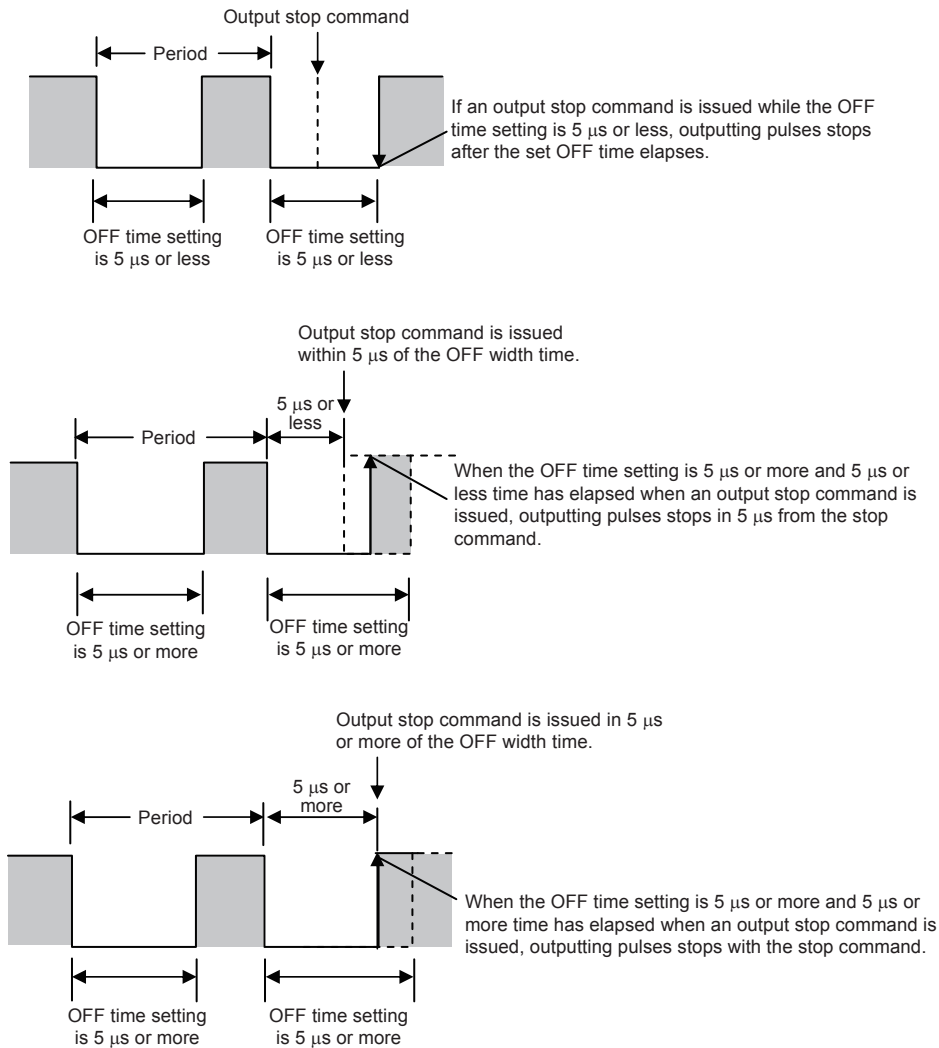
- The number of output pulses set to an SD device is valid for this instruction as well. The setting values are always read and updated.
- When the specified number of output pulses is equal to or less than the number of pulses which have already been output, pulse output stops after outputting pulses which are being output.
- When the specified number of output pulses is larger than the number of pulses which have already been output, pulse output stops after outputting set number of pulses.
- When the number of output pulses is set from the no limitation output setting (number of output pulses is 0), the number of output pulses is not updated (because outputting pulses continues or stops in the no limitation output).
- The maximum number of output pulses which can be output when the PWMH instruction is executed once (= maximum value which can be set to an SD device) is "2147483647".
- The ON time and period can be set during the pulse output. Setting values are always read and updated.
- When the number of output pulses is 0 (no limitation output setting), the monitor of the current number of output pulses is set to 0.
- When the number of output pulses is specified, the output pulses are monitored. When the PWMH output is executed several times, the monitor of the number of output pulses is an integrated value.
- The monitor of the current number of output pulses can be changed during the pulse output.
- The monitor of the current number of output pulses is updated when the number of pulses is counted at the falling edge of pulses in the positive logic and at the rising edge of pulses in the negative logic.
- When the output always remains ON or OFF, the monitor of the current number of output pulses does not change.
- The maximum value of the monitor of the current number of output pulses is "FFFFFFFFH". After the current number of output pulses reaches the maximum value, the monitor of the current number of output pulses starts to count again from "0".

## Precautions

- Specify the ON time by (s1) and the period by (s2) so that (s1) is equal to or larger than  $2\mu\text{s}$  and (s2) is equal to or larger than  $5\mu\text{s}$ .
- When a channel number that is not selected for the PWM output in the parameter setting is specified for (d), this instruction is not executed. An operation error occurs.
- Operations when the PWM output is stopped (while the output pulse is on)



- Operations when the PWM output is stopped (while the output pulse is off)



- The PWM output stops when SM9904 is on, and starts when it is off.
- PWM output does not stop, even if a pulse stop command for positioning is driven.
- When specifying the number of output pulses, executing the PWMH instruction, and then outputting pulses again after the pulse output stops due to the completion of output of the specified number of pulses, turn OFF the contact which drove the PWMH instruction. When driving PWM output by the HIOEN instruction, use the HIOEN instruction to turn PWM output off.
- When the period setting is equivalent to the ON time setting, the output always remains ON. The output ON state continues even after "Period  $\times$  Number of output pulses" is finished in this condition.
- Pulse output does not start even when the PWMH instruction is added during an online change. When the drive contact is on, pulse output can be started by turning the drive contact off and on.
- When the PWMH instruction is changed or deleted after online change occurs, pulse output is stopped.
- If an online change occurs while the PWMH instruction is present during pulse output, pulse output is stopped and the control right is released for the stopped channel.

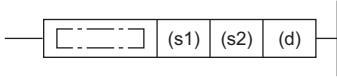
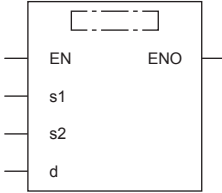
## Operation error

| Error code (SD0)                                     | Description                                                                                                               |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| 1810H                                                | The output destination specified by (d) is already used by another instruction (positioning instruction).                 |
| 1820H                                                | An online change was performed for a program file in which the PWMH instruction was operating.                            |
| 2221H                                                | The parameter set value is out of range.                                                                                  |
| 3285H                                                | Out-of-range data is specified in (s1) or (s2).                                                                           |
| 3600H                                                | A channel number that is not selected in the parameter setting are specified for the output destination specified by (d). |
| 3611H(CH1)<br>3612H(CH2)<br>3613H(CH3)<br>3614H(CH4) | This instruction is executed with a setting in which (s2) is smaller than (s1).                                           |

## 32 bit binary pulse width modulation

### DPWMH

This instruction outputs the pulse (in 32-bit data units) of the ON time (in 32-bit data units) specified by (s1) and the period specified by (s2) to the output destination specified by (d).

| Ladder diagram                                                                    | Structured text                   |
|-----------------------------------------------------------------------------------|-----------------------------------|
|  | <pre>ENO:=DPWM(EN,s1,s2,d);</pre> |
| FBD/LD                                                                            |                                   |
|  |                                   |

### Setting data

#### ■Descriptions, ranges, and data types

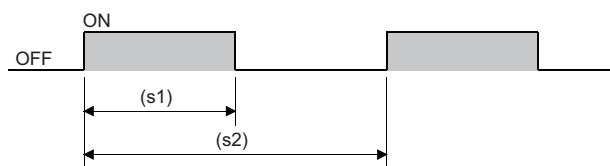
| Operand | Description                                                  | Range           | Data type              | Data type (label) |
|---------|--------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s1)    | Device number where the ON time (pulse width data) is stored | 1 to 2147483647 | 32-bit unsigned binary | ANY32             |
| (s2)    | Device number where the cyclic data is stored                | 1 to 2147483647 | 32-bit unsigned binary | ANY32             |
| (d)     | Channel number from which pulses are to be output            | 1 to 12         | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition                                          | —               | Bit                    | BOOL              |
| ENO     | Execution result                                             | —               | Bit                    | BOOL              |

#### ■Applicable devices

| Operand | Bit                      | Word                              |                |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|--------------------------|-----------------------------------|----------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB | T, ST, C, D, W, SD, SW, R, ZR, RD | U□\G□, U3E□\G□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | ○                        | ○                                 | ○              | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                        | ○                                 | ○              | ○ | ○           | ○  | ○                      | ○        | — | —  | —      |
| (d)     | ○                        | ○                                 | ○              | ○ | —           | —  | —                      | ○        | — | —  | —      |

## Processing details

- This instruction outputs the pulse of the ON time specified by (s1) and the period specified by (s2) to the output destination specified by (d).



- Time with a unit selected in the parameter setting window ( $\mu\text{s}$  or  $\text{ms}$ ) can be specified by (s1) and (s2).
- The pulse output destination channel number selected in the parameter setting window can be specified by (d).
- This instruction store the number of pulses, pulse width, and period output from each channel to an SD device. The pulse width and period are stored in the units set by the parameters. When 0 is specified in the pulse output, pulses are output without any limitation.

| Pulse output destination channel | Number of output pulses | R/W | Initial value | Timing of reflection on operation                                                                                                                                     | Timing of clearing to initial value |
|----------------------------------|-------------------------|-----|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| CH1                              | SD5301, SD5300          | R/W | 0             | <ul style="list-style-type: none"> <li>When the DHCMOV instruction is executed*1</li> <li>When the DPWMH instruction is executed</li> <li>END processing</li> </ul>   | STOP/PAUSE→RUN                      |
| CH2                              | SD5317, SD5316          |     |               |                                                                                                                                                                       |                                     |
| CH3                              | SD5333, SD5332          |     |               |                                                                                                                                                                       |                                     |
| CH4                              | SD5349, SD5348          |     |               |                                                                                                                                                                       |                                     |
| CH5                              | SD5364, SD5365          |     |               |                                                                                                                                                                       |                                     |
| CH6                              | SD5380, SD5381          |     |               |                                                                                                                                                                       |                                     |
| CH7                              | SD5396, SD5397          |     |               |                                                                                                                                                                       |                                     |
| CH8                              | SD5412, SD5413          |     |               |                                                                                                                                                                       |                                     |
| CH9                              | SD5428, SD5429          |     |               |                                                                                                                                                                       |                                     |
| CH10                             | SD5444, SD5445          |     |               |                                                                                                                                                                       |                                     |
| CH11                             | SD5460, SD5461          |     |               |                                                                                                                                                                       |                                     |
| CH12                             | SD5476, SD5477          |     |               |                                                                                                                                                                       |                                     |
| Pulse output destination channel | ON time                 | R/W | Initial value | Timing of reflection on operation                                                                                                                                     | Timing of clearing to initial value |
| CH1                              | SD5303, SD5302          | R/W | 0*2           | <ul style="list-style-type: none"> <li>When the DHCMOV instruction is executed*1</li> <li>When the DPWMH instruction is executed*3</li> <li>END processing</li> </ul> | STOP/PAUSE→RUN                      |
| CH2                              | SD5319, SD5318          |     |               |                                                                                                                                                                       |                                     |
| CH3                              | SD5335, SD5334          |     |               |                                                                                                                                                                       |                                     |
| CH4                              | SD5351, SD5350          |     |               |                                                                                                                                                                       |                                     |
| CH5                              | SD5366, SD5367          |     |               |                                                                                                                                                                       |                                     |
| CH6                              | SD5382, SD5383          |     |               |                                                                                                                                                                       |                                     |
| CH7                              | SD5398, SD5399          |     |               |                                                                                                                                                                       |                                     |
| CH8                              | SD5414, SD5415          |     |               |                                                                                                                                                                       |                                     |
| CH9                              | SD5430, SD5431          |     |               |                                                                                                                                                                       |                                     |
| CH10                             | SD5446, SD5447          |     |               |                                                                                                                                                                       |                                     |
| CH11                             | SD5462, SD5463          |     |               |                                                                                                                                                                       |                                     |
| CH12                             | SD5478, SD5479          |     |               |                                                                                                                                                                       |                                     |

| Pulse output destination channel | Period         | R/W | Initial value   | Timing of reflection on operation                                                                                                                                                           | Timing of clearing to initial value |
|----------------------------------|----------------|-----|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| CH1                              | SD5305, SD5304 | R/W | 0 <sup>*2</sup> | <ul style="list-style-type: none"> <li>When the DHCMOV instruction is executed<sup>*1</sup></li> <li>When the DPWMH instruction is executed<sup>*3</sup></li> <li>END processing</li> </ul> | STOP/PAUSE→RUN                      |
| CH2                              | SD5321, SD5320 |     |                 |                                                                                                                                                                                             |                                     |
| CH3                              | SD5337, SD5336 |     |                 |                                                                                                                                                                                             |                                     |
| CH4                              | SD5353, SD5352 |     |                 |                                                                                                                                                                                             |                                     |
| CH5                              | SD5368, SD5369 |     |                 |                                                                                                                                                                                             |                                     |
| CH6                              | SD5384, SD5385 |     |                 |                                                                                                                                                                                             |                                     |
| CH7                              | SD5400, SD5401 |     |                 |                                                                                                                                                                                             |                                     |
| CH8                              | SD5416, SD5417 |     |                 |                                                                                                                                                                                             |                                     |
| CH9                              | SD5432, SD5433 |     |                 |                                                                                                                                                                                             |                                     |
| CH10                             | SD5448, SD5449 |     |                 |                                                                                                                                                                                             |                                     |
| CH11                             | SD5464, SD5465 |     |                 |                                                                                                                                                                                             |                                     |
| CH12                             | SD5480, SD5481 |     |                 |                                                                                                                                                                                             |                                     |

\*1 When the DHCMOV instruction is used, the latest value can be read. A writable device can be updated immediately.

\*2 Parameter setting values are set to an SD device at STOP to RUN.

\*3 When this instruction is executed, the pulse width and period specified (s1) and (s2) are set to an SD device.

• After the pulse output is started from each channel, the pulse output monitor turns on.

| Pulse output destination channel | Pulse output monitor | R/W | Initial value | ON timing                                                                                                                                 | OFF timing                                                                                                                                                                                          |
|----------------------------------|----------------------|-----|---------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CH1                              | SM5300               | R   | Off           | <ul style="list-style-type: none"> <li>When the DHIOEN instruction is executed</li> <li>When the DPWMH instruction is executed</li> </ul> | <ul style="list-style-type: none"> <li>Power-on</li> <li>Reset</li> <li>RUN→STOP/PAUSE</li> <li>When the specified number of pulses are output.</li> <li>The drive contact is turned off</li> </ul> |
| CH2                              | SM5301               |     |               |                                                                                                                                           |                                                                                                                                                                                                     |
| CH3                              | SM5302               |     |               |                                                                                                                                           |                                                                                                                                                                                                     |
| CH4                              | SM5303               |     |               |                                                                                                                                           |                                                                                                                                                                                                     |
| CH5                              | SM5304               |     |               |                                                                                                                                           |                                                                                                                                                                                                     |
| CH6                              | SM5305               |     |               |                                                                                                                                           |                                                                                                                                                                                                     |
| CH7                              | SM5306               |     |               |                                                                                                                                           |                                                                                                                                                                                                     |
| CH8                              | SM5307               |     |               |                                                                                                                                           |                                                                                                                                                                                                     |
| CH9                              | SM5308               |     |               |                                                                                                                                           |                                                                                                                                                                                                     |
| CH10                             | SM5309               |     |               |                                                                                                                                           |                                                                                                                                                                                                     |
| CH11                             | SM5310               |     |               |                                                                                                                                           |                                                                                                                                                                                                     |
| CH12                             | SM5311               |     |               |                                                                                                                                           |                                                                                                                                                                                                     |

• This instruction stores the number of pulses output from each channel.

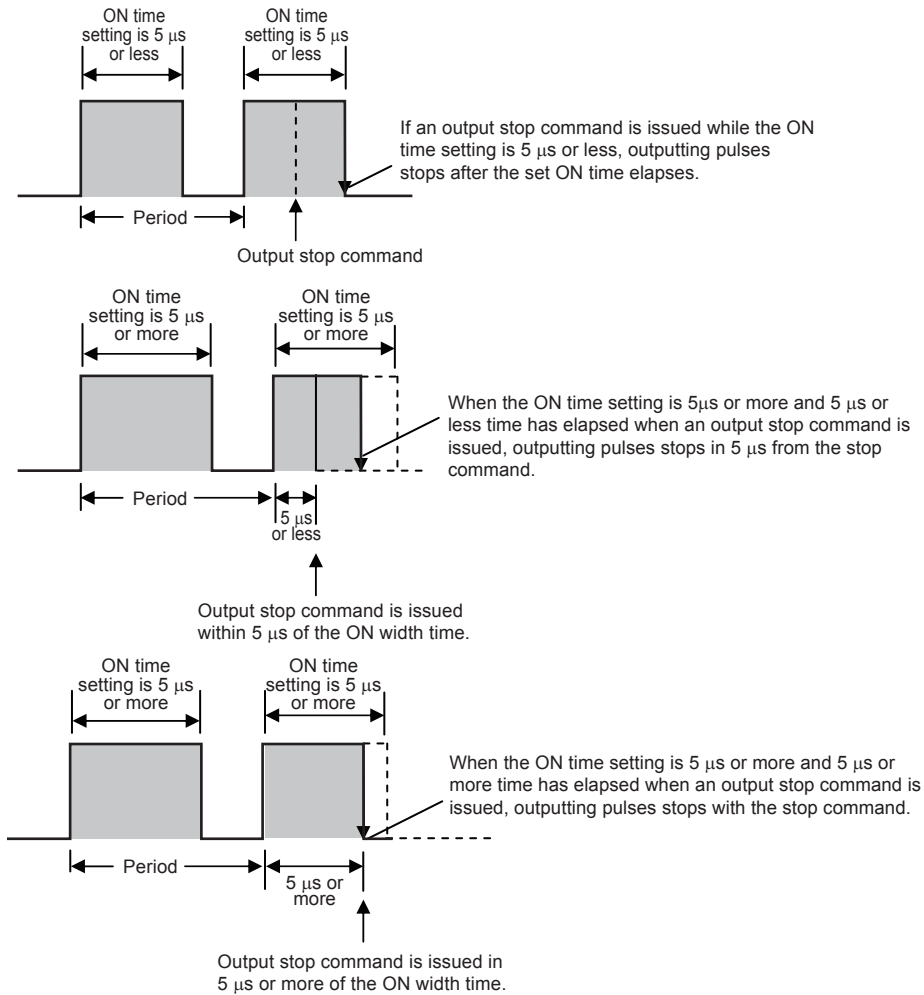
| Pulse output destination channel | Monitoring the current number of output pulses | R/W | Initial value | Timing of reflection on operation                                                                                                                    | Timing of clearing to initial value                                                                 |
|----------------------------------|------------------------------------------------|-----|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| CH1                              | SD5307, SD5306                                 | R/W | 0             | <ul style="list-style-type: none"> <li>When the DHCMOV instruction is executed</li> <li>→ An SD device is updated</li> <li>END processing</li> </ul> | <ul style="list-style-type: none"> <li>Power-on</li> <li>Reset</li> <li>STOP/PAUSE → RUN</li> </ul> |
| CH2                              | SD5323, SD5322                                 |     |               |                                                                                                                                                      |                                                                                                     |
| CH3                              | SD5339, SD5338                                 |     |               |                                                                                                                                                      |                                                                                                     |
| CH4                              | SD5355, SD5354                                 |     |               |                                                                                                                                                      |                                                                                                     |

- The number of output pulses set to an SD device is valid for this instruction as well. The setting values are always read and updated.
- When the specified number of output pulses is equal to or less than the number of pulses which have already been output, pulse output stops after outputting pulses which are being output.
- When the specified number of output pulses is larger than the number of pulses which have already been output, pulse output stops after outputting set number of pulses.
- When the number of output pulses is set from the no limitation output setting (number of output pulses is 0), the number of output pulses is not updated (because outputting pulses continues or stops in the no limitation output).
- The maximum number of output pulses which can be output when the DPWMH instruction is executed once (= maximum value which can be set to an SD device) is "2147483647".
- The ON time and period can be set during the pulse output. Setting values are always read and updated.
- When the number of output pulses is 0 (no limitation output setting), the monitor of the current number of output pulses is set to 0.
- When the number of output pulses is specified, the output pulses are monitored. When the DPWMH output is executed several times, the monitor of the number of output pulses is an integrated value.
- The monitor of the current number of output pulses can be changed during the pulse output.
- The monitor of the current number of output pulses is updated when the number of pulses is counted at the falling edge of pulses in the positive logic and at the rising edge of pulses in the negative logic.
- When the output always remains ON or OFF, the monitor of the current number of output pulses does not change.
- The maximum value of the monitor of the current number of output pulses is "FFFFFFFFH". After the current number of output pulses reaches the maximum value, the monitor of the current number of output pulses starts to count again from "0".

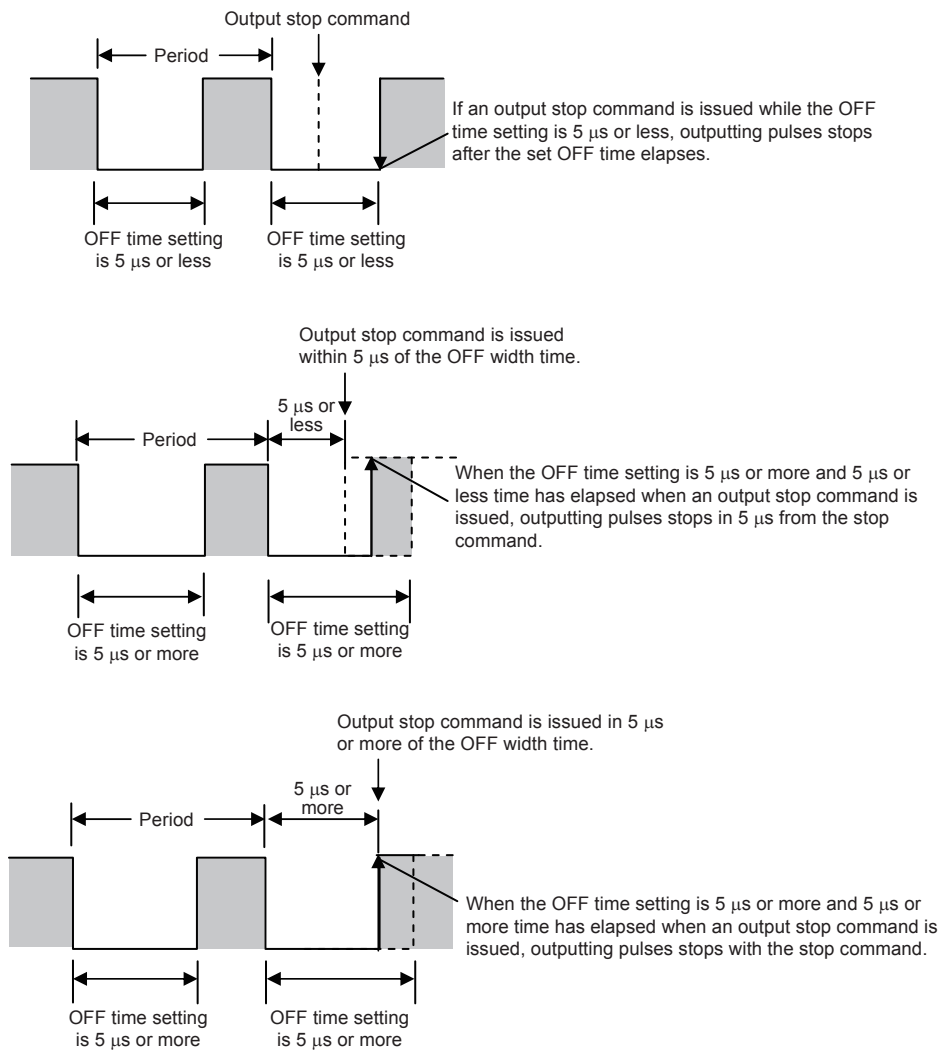


## Precautions

- Specify the ON time by (s1) and the period by (s2) so that (s1) is equal to or larger than  $2\mu\text{s}$  and (s2) is equal to or larger than  $5\mu\text{s}$ .
- When a negative value is specified for the ON time by (s1) and the period by (s2), an operation error occurs.
- When a channel number that has not been selected for the PWMH output in the parameter setting is specified for (d), this instruction is not executed. An operation error occurs.
- Operations when the DPWM output is stopped (while the output pulse is on)



- Operations when the DPWMH output is stopped (while the output pulse is off)



- The PWM output stops when SM9904 is on, and starts when it is off.
- PWM output does not stop, even if a pulse stop command for positioning is driven.
- When specifying the number of output pulses, executing the DPWMH instruction, and then outputting pulses again after the pulse output stops due to the completion of output of the specified number of pulses, turn OFF the contact which drove the DPWMH instruction. When driving PWM output by the DHIOEN instruction, use the DHIOEN instruction to turn PWM output off.
- When the period setting is equivalent to the ON time setting, the output always remains ON. The output ON state continues even after "Period  $\times$  Number of output pulses" is finished in this condition.

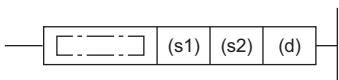
| Error code (SD0)                                     | Description                                                                                                               |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| 1810H                                                | The output destination specified by (d) is already used by another instruction (positioning instruction).                 |
| 1820H                                                | This instruction is operating when an online change occurs.                                                               |
| 2221H                                                | The parameter set value is out of range.                                                                                  |
| 3285H                                                | Out-of-range data is specified in (s1) or (s2).                                                                           |
| 3600H                                                | A channel number that is not selected in the parameter setting are specified for the output destination specified by (d). |
| 3611H(CH1)<br>3612H(CH2)<br>3613H(CH3)<br>3614H(CH4) | This instruction is executed with a setting in which (s2) is smaller than (s1).                                           |

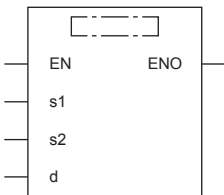
## 28.2 Measuring the Density of 16 Bit Binary/32 Bit Binary Pulses

### Measuring the density of 16 bit data pulses

#### SPDH

Measures the input pulse for the specified time with interrupt input.

| Ladder diagram                                                                    | Structured text        |
|-----------------------------------------------------------------------------------|------------------------|
|  | ENO:=SPDH(EN,s1,s2,d); |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

#### Setting data

#### ■Descriptions, ranges, and data types

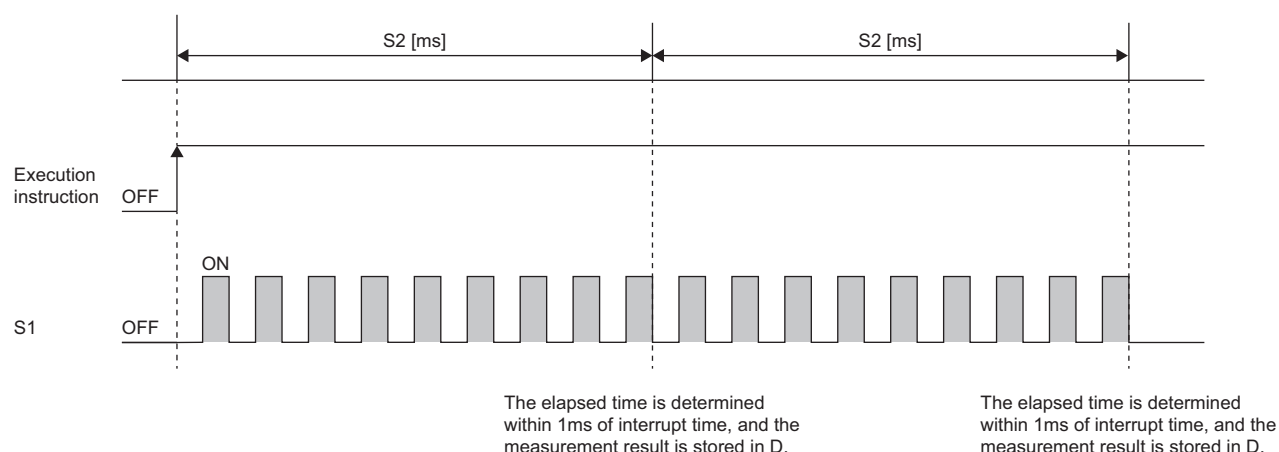
| Operand | Description                                                       | Range      | Data type              | Data type (label) |
|---------|-------------------------------------------------------------------|------------|------------------------|-------------------|
| (s1)    | High-speed counter channel number to which pulses are to be input | 1 to 8     | 16-bit unsigned binary | ANY16             |
| (s2)    | Word device where the time (ms) data or data is stored            | 0 to 65535 | 16-bit unsigned binary | ANY16             |
| (d)     | Start word device number storing the pulse density data           | —          | 16-bit unsigned binary | ANY16             |
| EN      | Execution condition                                               | —          | Bit                    | BOOL              |
| ENO     | Execution result                                                  | —          | Bit                    | BOOL              |

#### ■Applicable devices

| Operand | Bit                      | Word                              |                |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|--------------------------|-----------------------------------|----------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB | T, ST, C, D, W, SD, SW, R, ZR, RD | U□\G□, U3E□\G□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s3)    | —                        | ○                                 | —              | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

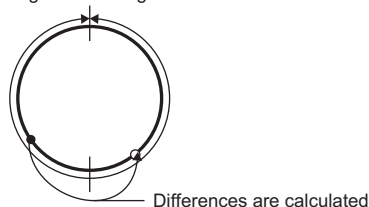
This instruction counts the device input specified by (s1) only for the time specified by (s2) and stores the operation result in the device specified by (d).



## Precautions

- The maximum frequency of turning the X00 to X0F inputs on and off is 200kHz for X00 to X05 and 10kHz for X06 and X07.
- When the measurement time of the operand is changed while the SPDH instruction is executed, the changed time is applied every time the measurement time ends.
- When the current value of the high-speed counter is overwritten by the HCMOV instruction or the current value is changed by an external preset input or reset by itself while the SPDH instruction is executed, the pulse density cannot be measured normally. (The operation continues.)
- When the SPDH instruction is used, do not input the number of pulses that exceeds the ring length of the high-speed counter/2 within the measurement time. If such value is input, the number of pulses cannot be calculated correctly.

Ring counter length/2



- The measurement time specified by the operand of the SPDH instruction overwrites the SD of the measurement unit time used for the pulse density (rotation speed) measurement function.
- When the measurement time is outside the range from 1 to 2147483647, the specified measurement time is rounded into "1" with the sign.
- For the SPDH instruction, only the channel number in which the high-speed counter parameters are set can be specified. Specify the channel number or the X number of phase A for (s1). If a channel to which no parameters are set is specified, the operation error H3600 occurs.
- When the SPDH instruction is executed, the UP/DOWN pulse input, preset input, and enable input operate in accordance with the parameter settings of the high-speed counter.
- When the SPDH instruction starts or stops, the common high-speed counter function starts or stops simultaneously with the pulse density measurement function.
- In a state where the high-speed counter has been driven by the HIOEN instruction (K0: High-speed counter), the pulse density measurement does not start and no error occurs even when driving is performed while specifying a running channel for the SPDH instruction.

## Operation error

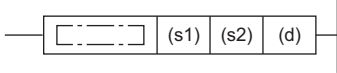
| Error code (SD0) | Description                                                                                                     |
|------------------|-----------------------------------------------------------------------------------------------------------------|
| 1810H            | A channel number which is used in another instruction is specified in (s1).                                     |
| 3285H            | An unavailable bit device is specified in (s1).<br>A channel number other than CH1 to CH8 is specified in (s1). |
| 3600H            | A channel number or word device that is not selected in the parameter setting is specified in (s1).             |

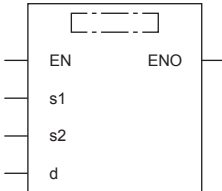
# Measuring the density of 32 bit data pulses

28

## DSPDH

Measures the input pulse for the specified time with interrupt input.

| Ladder diagram                                                                    | Structured text                    |
|-----------------------------------------------------------------------------------|------------------------------------|
|  | <pre>ENO:=DSPDH(EN,s1,s2,d);</pre> |

| FBD/LD                                                                            |
|-----------------------------------------------------------------------------------|
|  |

## Setting data

### ■Descriptions, ranges, and data types

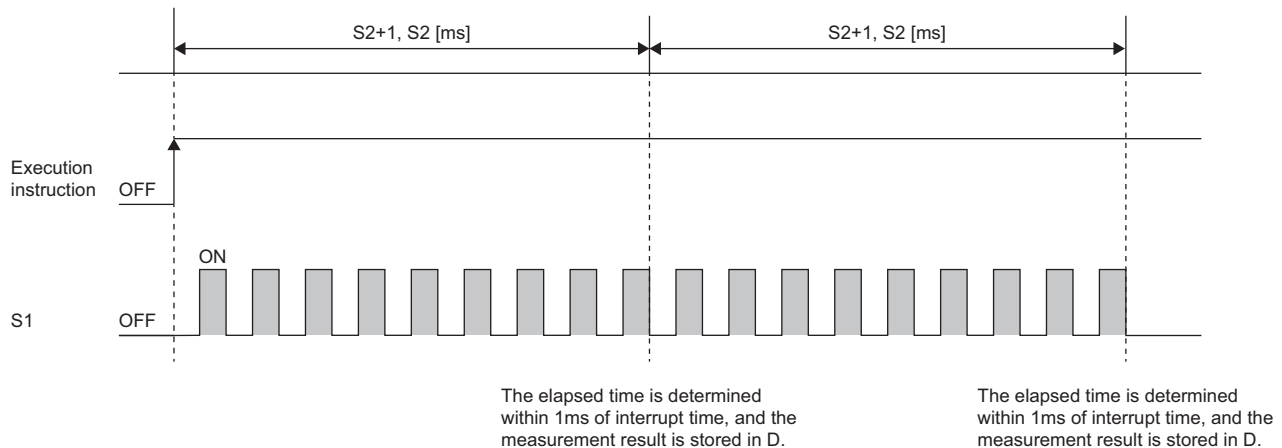
| Operand | Description                                                       | Range           | Data type              | Data type (label) |
|---------|-------------------------------------------------------------------|-----------------|------------------------|-------------------|
| (s1)    | High-speed counter channel number to which pulses are to be input | 1 to 8          | 32-bit unsigned binary | ANY32             |
| (s2)    | Word device where the time (ms) data or data is stored            | 1 to 2147483647 | 32-bit unsigned binary | ANY32             |
| (d)     | Start word device number storing the pulse density data           | —               | 32-bit unsigned binary | ANY32             |
| EN      | Execution condition                                               | —               | Bit                    | BOOL              |
| ENO     | Execution result                                                  | —               | Bit                    | BOOL              |

### ■Applicable devices

| Operand | Bit                      | Word                              |                |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|--------------------------|-----------------------------------|----------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, L, SM, F, B, SB | T, ST, C, D, W, SD, SW, R, ZR, RD | U□\G□, U3E□\G□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | ○                        | ○                                 | ○              | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s3)    | —                        | ○                                 | —              | — | —           | —  | ○                      | —        | — | —  | —      |

## Processing details

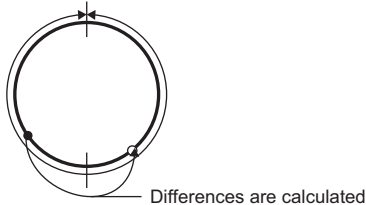
This instruction counts the device input specified by (s1) only for the time specified by (s2)+1 or (s2) and stores the operation result in the device specified by (d)+1 or (d).



## Precautions

- The maximum frequency of turning the X00 to X0F inputs on and off is 200kHz for X00 to X05 and 10kHz for X06 and X07.
- When the measurement time of the operand is changed while the SPDH instruction is executed, the changed time is applied every time the measurement time ends.
- When the current value of the high-speed counter is overwritten by the HCMOV instruction or the current value is changed by an external preset input or reset by itself while the SPDH instruction is executed, the pulse density cannot be measured normally. (The operation continues.)
- When the SPDH instruction is used, do not input the number of pulses that exceeds the ring length of the high-speed counter/2 within the measurement time. If such value is input, the number of pulses cannot be calculated correctly.

Ring counter length/2



- The measurement time specified by the operand of the SPDH instruction overwrites the SD of the measurement unit time used for the pulse density (rotation speed) measurement function.
- When the measurement time is outside the range from 1 to 2147483647, the specified measurement time is rounded into "1" with the sign.
- For the SPDH instruction, only the channel number in which the high-speed counter parameters are set can be specified. Specify the channel number or the X number of phase A for (s1). If a channel to which no parameters are set is specified, the operation error H3600 occurs.
- When the SPDH instruction is executed, the UP/DOWN pulse input, preset input, and enable input operate in accordance with the parameter settings of the high-speed counter.
- When the SPDH instruction starts or stops, the common high-speed counter function starts or stops simultaneously with the pulse density measurement function.
- In a state where the high-speed counter has been driven by the HIOEN instruction (K0: High-speed counter), the pulse density measurement does not start and no error occurs even when driving is performed while specifying a running channel for the SPDH instruction.



## Operation error

28

| Error code (SD0) | Description                                                                                                     |
|------------------|-----------------------------------------------------------------------------------------------------------------|
| 1810H            | A channel number which is used in another instruction is specified in (s1).                                     |
| 3285H            | An unavailable bit device is specified in (s1).<br>A channel number other than CH1 to CH8 is specified in (s1). |
| 3600H            | A channel number or word device that is not selected in the parameter setting is specified in (s1).             |



# PART 5

# NETWORK INSTRUCTIONS

This part consists of the following chapters.

For the dedicated instructions in using the intelligent function module with the MX-F model, refer to the following.

 MELSEC iQ-F FX5 Programming Manual (Instructions, Standard Functions/Function Blocks)

29 Ethernet INSTRUCTIONS

---

30 EXTERNAL DEVICE COMMUNICATION INSTRUCTIONS

---

# 29 Ethernet INSTRUCTIONS

For the dedicated instructions in using the intelligent function module with the MX-F model, refer to the following.  
MELSEC iQ-F FX5 Programming Manual (Instructions, Standard Functions/Function Blocks)

## 29.1 Open/Close Processing Instructions

Point

For connections where any of the following instructions is being executed, a request is ignored even if the following multiple instructions are attempted to be executed.

At this time, as long as the execution conditions of the instruction executed later are met, the request is executed after the first instruction being executed completes. SM699 (Dedicated instruction skip flag) turns on while the request is ignored.

- SOCOPEN instruction
- SOCCLOSE instruction
- SOCSND instruction
- SOCRCV instruction
- ECPRTCL instruction

### Opening a connection

#### GP.SOCOPEN, SP.SOCOPEN

This instruction opens the specified connection.

| Ladder | ST                                                               |
|--------|------------------------------------------------------------------|
|        | ENO:=GP_SOCOPEN(EN,U,s1,s2,d);<br>ENO:=SP_SOCOPEN(EN,U,s1,s2,d); |

| FBD/LD |
|--------|
|        |

#### Execution condition

| Instruction              | Execution condition |
|--------------------------|---------------------|
| GP.SOCOPEN<br>SP.SOCOPEN |                     |

## ■Description, range, data type

| Operand |            | Description                                                                                                                                | Range                      | Data type              | Data type (label)                       |
|---------|------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------|-----------------------------------------|
| (U)     | GP.SOCOPEN | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number)                                                       | 3E0H                       | 16-bit unsigned binary | ANY16                                   |
|         | SP.SOCOPEN | Dummy                                                                                                                                      | —                          | String                 | ANYSTRING_SINGLE                        |
| (s1)    |            | Connection number                                                                                                                          | 1 to 32                    | 16-bit unsigned binary | ANY16                                   |
| (s2)    | GP.SOCOPEN | Start device where control data is stored                                                                                                  | Refer to the control data. | Device                 | ANY16                                   |
|         | SP.SOCOPEN |                                                                                                                                            |                            | Word                   | ANY16_ARRAY<br>(Number of elements: 10) |
| (d)     |            | Device that turns on for one scan upon completion of the instruction<br>When the instruction completes with an error, (d)+1 also turns on. | —                          | Bit                    | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      |            | Execution condition                                                                                                                        | —                          | Bit                    | BOOL                                    |
| ENO     |            | Execution result                                                                                                                           | —                          | Bit                    | BOOL                                    |

## ■Applicable devices

| Operand | Bit        | Word                             |     |                                       |            | Double word |             | Indirect specification | Constant |   |    | Others (U) |
|---------|------------|----------------------------------|-----|---------------------------------------|------------|-------------|-------------|------------------------|----------|---|----|------------|
|         |            | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z           | LT, LST, LC | LZ                     | K, H     | E | \$ |            |
| (U)     | GP.SOCOPEN | —                                | —   | ○                                     | —          | —           | —           | ○                      | ○        | — | —  | ○          |
|         | SP.SOCOPEN | —                                | —   | ○                                     | —          | —           | —           | ○                      | —        | — | ○  | ○          |
| (s1)    |            | —                                | —   | ○                                     | —          | —           | —           | ○                      | ○        | — | —  | —          |
| (s2)    |            | —                                | —   | ○                                     | —          | —           | —           | ○                      | —        | — | —  | —          |
| (d)     |            | ○                                | —   | ○                                     | —          | —           | —           | ○                      | —        | — | —  | —          |

## ■Control data

| Operand: (s2) |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |        |     |     |     |   |   |      |
|---------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|-----|-----|-----|---|---|------|
| Device        | Item                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Setting range  | Set by |     |     |     |   |   |      |
| +0            | Execution/completion type | Specify whether to use the parameter value set by the engineering tool or the value set in (s2)+2 to (s2)+9 of control data for opening a connection.<br>• 0000H: Performs open processing according to the "open setting" by the engineering tool.<br>• 8000H: Performs open processing according to the settings in (s2)+2 to (s2)+9 of control data.*3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0000H<br>8000H | User   |     |     |     |   |   |      |
| +1            | Completion status         | The completion status is stored upon completion of the instruction.<br>• 0000H: Completed successfully<br>• Other than 0000H: Completed with an error (error code)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | —              | System |     |     |     |   |   |      |
| +2            | Application setting area  | Specify the application of a connection.<br><div style="text-align: center;"><div>b15 b14    ...    b10 b9 b8 b7    ...    b0</div><div>(s2)+2   <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="width: 20px; text-align: center;">(3)</td><td style="width: 20px; text-align: center;">0</td><td style="width: 20px; text-align: center;">(4)</td><td style="width: 20px; text-align: center;">(2)</td><td style="width: 20px; text-align: center;">(1)</td><td style="width: 20px; text-align: center;">0</td></tr></table></div></div> <div>(1) Communication method (protocol) (b8 and 7)<br/>• 00: TCP<br/>• 01: TLS<br/>• 10: UDP<br/>• 11:DTLS<br/>(2) Socket communications function procedure (b9)<br/>• 1: No procedure (fixed)<br/>(3) Open method (b15, b14)<br/>• 00: Active open or UDP<br/>• 10: Unpassive open<br/>• 11: Fullpassive open<br/>(4) Predefined protocol setting (b10)<br/>• 0: Do not use the predefined protocol support function. (Use the socket communications function.)<br/>• 1: Use the predefined protocol support function.</div> | (3)            | 0      | (4) | (2) | (1) | 0 | — | User |
| (3)           | 0                         | (4)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | (2)            | (1)    | 0   |     |     |   |   |      |

| Operand: (s2) |                                             |                                                                                                                 |                                                               |        |
|---------------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|--------|
| Device        | Item                                        | Description                                                                                                     | Setting range                                                 | Set by |
| +3            | Own station port number.                    | Specify the port number of the own station.                                                                     | 1 to 4999, 5010 to 65534<br>(0001H to 1387H, 1392H to FFFE H) | User   |
| +4<br>+5      | IP address of external device <sup>*1</sup> | Specify the IP address of an external device.<br>To enable broadcast communications, specify FFFFFFFFH.         | 00000001H to FFFFFFFFH                                        | User   |
| +6            | Destination port number <sup>*1</sup>       | Specify the destination port number.<br>When receiving data from all port numbers, specify FFFFH. <sup>*2</sup> | 1 to 65535<br>(0001H to FFFFH)                                | User   |
| +7 to +9      | —                                           | Reserved                                                                                                        | —                                                             | System |

\*1 In Unpassive open mode, the IP address of the external device and destination port number are ignored.

\*2 If 65535 (FFFFH) is specified for the port number, data cannot be sent. To send data, specify a value within the range of 1 to 65534 (1 to FFFE H).

\*3 The setting items that are not included in the control data are as follows.

Alive check: KeepAlive (for TCP/TLS), UDP (for UDP/DTLS)

Connection monitoring timer setting: Invalid

### Point

Since port numbers 0001H to 03FFH are generally reserved port numbers (WELL KNOWN PORT NUMBERS) and F000H to FFFE H are used dynamically by the other functions, use of port numbers 0400H to 1387H and 1392H to EFFFH is recommended.

## Processing details

- This instruction opens the connection specified by (s1). The setting value used for open processing is selected by (s2)+0.
- The execution status and the completion status of this instruction can be checked with the completion device (d) specified by the setup data and the completion status indication device (d)+1.

- Completion device (d)

This device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

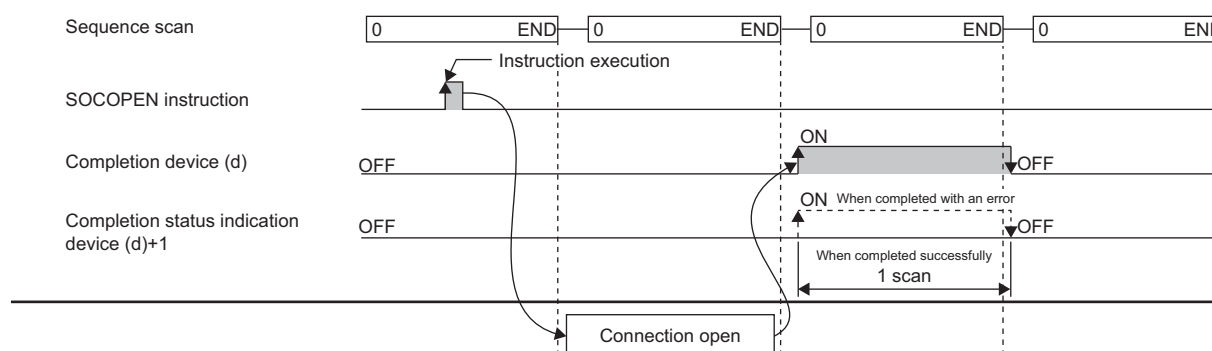
- Completion status indication device (d)+1

This device turns on or off depending on the completion status of this instruction.

Completed successfully: The device remains off.

Completed with an error: The device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

- The following figure shows the execution timing of this instruction.



- A connection which has not been set by a parameter (a connection whose protocol field is left blank) can be opened and used. To do so, set (s2)+0 to 8000H and specify the details of open in (s2)+1 to (s2)+9 of control data.

### Point

This instruction supports the encrypted predefined protocols (TLS and DTLS). For more details, check the user's manual for the controller used.

## Precautions

- The following table describes precautions to be taken when establishing a connection on an Ethernet port. For details on how to check the connection status, check the user's manual for the controller used.

| Item                                                                                                                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A connection is established with TCP/IP or TLS protocol, and in FullPassive mode                                                      | <p>After executing this instruction, if a connection request is received from an external device with an IP address that is not set in the external device connection configuration, a normal response is returned, but then the connection is disconnected. From the perspective of the external device, the connection is established once and then disconnected.</p> <p>For how to check whether the connection establishment is successful, check the completion status of the following instructions. If the connection establishment is successful, 0000H is stored. If the connection establishment fails, C1B1H is stored.</p> <ul style="list-style-type: none"> <li>• SOCSND instruction</li> <li>• SOCRCV instruction</li> <li>• SOCCSET instruction</li> <li>• ECPRTCL instruction</li> </ul>                                                                                         |
| A connection is established again after establishing a connection with TCP/IP or TLS protocol, and in FullPassive mode/UnPassive mode | <p>While a connection has been established by a connection request from the external device after executing this instruction, if another connection request is received from the external device, the request will not be accepted and the connection will be disconnected. (For example, the external device may be reset before executing the SOCCLOSE instruction after establishing the connection, and the external device may request to open the connection again.)</p> <p>The controller requires several hundred milliseconds to be able to accept the connection request again, so the external device should wait 1 to 2 seconds after checking the disconnection before sending another connection request.</p> <p>Also, to determine whether the reconnection request on the external device was successful, check whether the connection status on the external device is open.</p> |

- Do not execute the Ethernet function add-on and the Ethernet instruction at the same time. If they are executed at the same time, malfunction may occur.

## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port. |
| 3285H            | The connection number specified by (s1) is outside the range.                           |

Upon completion with an error, the completion status indication device (d)+1 is turned on and an error code is stored in the completion status (s2)+1.

For the error code stored in the completion status (s2)+1, refer to the following.

 User's manual for the controller used

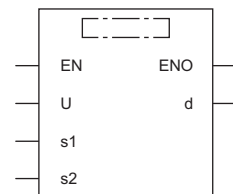
# Closing a connection

## GP.SOCCLOSE, SP.SOCCLOSE

This instruction closes the specified connection.

| Ladder | ST                                                                         |
|--------|----------------------------------------------------------------------------|
|        | <pre>ENO:=GP_SOCCLOSE(EN,U,s1,s2,d); ENO:=SP_SOCCLOSE(EN,U,s1,s2,d);</pre> |

## FBD/LD



## Execution condition

| Instruction                | Execution condition |
|----------------------------|---------------------|
| GP.SOCCLOSE<br>SP.SOCCLOSE |                     |

## Setting data

## Description, range, data type

| Operand |             | Description                                                                                                                                | Range                      | Data type              | Data type (label)                       |
|---------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------|-----------------------------------------|
| (U)     | GP.SOCCLOSE | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number)                                                       | 3E0H                       | 16-bit unsigned binary | ANY16                                   |
|         | SP.SOCCLOSE | Dummy                                                                                                                                      | —                          | String                 | ANYSTRING_SINGLE                        |
| (s1)    |             | Connection number                                                                                                                          | 1 to 32                    | 16-bit unsigned binary | ANY16                                   |
| (s2)    | GP.SOCCLOSE | Start device where control data is stored                                                                                                  | Refer to the control data. | Device                 | ANY16                                   |
|         | SP.SOCCLOSE |                                                                                                                                            |                            | Word                   | ANY16_ARRAY<br>(Number of elements: 2)  |
| (d)     |             | Device that turns on for one scan upon completion of the instruction<br>When the instruction completes with an error, (d)+1 also turns on. | —                          | Bit                    | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      |             | Execution condition                                                                                                                        | —                          | Bit                    | BOOL                                    |
| ENO     |             | Execution result                                                                                                                           | —                          | Bit                    | BOOL                                    |

## Applicable devices

| Operand |             | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|-------------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|         |             | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | GP.SOCCLOSE | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | ○  | ○          |
|         | SP.SOCCLOSE | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | ○          |
| (s1)    |             | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —          |
| (s2)    |             | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |
| (d)     |             | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |



## Control data

| Operand: (s2) |                   |                                                                                                                                                                    |               |        |
|---------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item              | Description                                                                                                                                                        | Setting range | Set by |
| +0            | System area       | —                                                                                                                                                                  | —             | —      |
| +1            | Completion status | The completion status is stored upon completion of the instruction.<br>• 0000H: Completed successfully<br>• Other than 0000H: Completed with an error (error code) | —             | System |

## Processing details

- This instruction performs close processing for the connection specified by (s1).
- The execution status and the completion status of this instruction can be checked with the completion device (d) specified by the setup data and the completion status indication device (d)+1.

- Completion device (d)

This device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

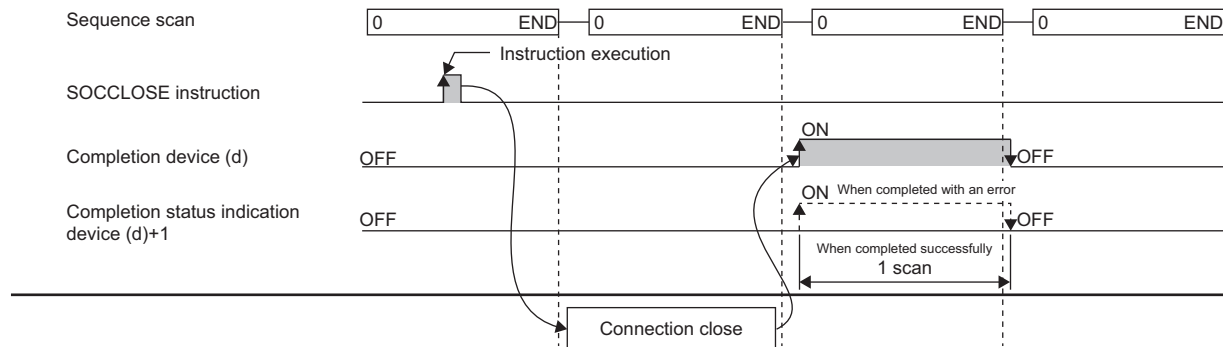
- Completion status indication device (d)+1

This device turns on or off depending on the completion status of this instruction.

Completed successfully: The device remains off.

Completed with an error: The device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

- The following figure shows the execution timing of this instruction.



## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port. |
| 3285H            | The connection number specified by (s1) is outside the range.                           |

Upon completion with an error, the completion status indication device (d)+1 is turned on and an error code is stored in the completion status (s2)+1.

For the error code stored in the completion status (s2)+1, refer to the following.

📖 User's manual for the controller used

### Point

When a connection waiting for opening the SOCCLOSE instruction is specified in TCP/TLS/DTLS Passive mode, a successful completion occurs when the SOCOPEN or SOCCLOSE instruction is issued and the connection is closed.

# 29.2 Socket Communications Instructions



For connections where any of the following instructions is being executed, a request is ignored even if the following multiple instructions are attempted to be executed.

At this time, as long as the execution conditions of the instruction executed later are met, the request is executed after the first instruction being executed completes. SM699 (Dedicated instruction skip flag) turns on while the request is ignored.

- SOCOPEN instruction
- SOCCLOSE instruction
- SOCSND instruction
- SOCRCV instruction
- ECPRTCL instruction

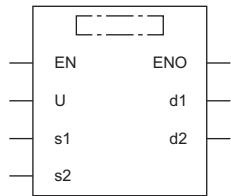
## Reading receive data during the END processing

### GP.SOCRCV, SP.SOCRCV

This instruction reads the receive data of the specified connection, during END processing after instruction execution, from the socket communications receive data area.

| Ladder | ST                                                                     |
|--------|------------------------------------------------------------------------|
|        | ENO:=GP_SOCRCV(EN,U,s1,s2,d1,d2);<br>ENO:=SP_SOCRCV(EN,U,s1,s2,d1,d2); |

### FBD/LD



### Execution condition

| Instruction            | Execution condition |
|------------------------|---------------------|
| GP.SOCRCV<br>SP.SOCRCV |                     |

## Setting data

### ■Description, range, data type

| Operand |           | Description                                                                                                                                 | Range                      | Data type              | Data type (label)                       |
|---------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------|-----------------------------------------|
| (U)     | GP.SOCRCV | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number)                                                        | 3E0H                       | 16-bit unsigned binary | ANY16                                   |
|         | SP.SOCRCV | Dummy                                                                                                                                       | —                          | String                 | ANYSTRING_SINGLE                        |
| (s1)    |           | Connection number                                                                                                                           | 1 to 32                    | 16-bit unsigned binary | ANY16                                   |
| (s2)    | GP.SOCRCV | Start device where control data is stored                                                                                                   | Refer to the control data. | Device                 | ANY16                                   |
|         | SP.SOCRCV |                                                                                                                                             |                            | Word                   | ANY16_ARRAY<br>(Number of elements: 2)  |
| (d1)    | GP.SOCRCV | Start device for storing the receive data                                                                                                   | —                          | Device                 | ANY16* <sup>1</sup>                     |
|         | SP.SOCRCV |                                                                                                                                             |                            | Word                   |                                         |
| (d2)    |           | Device that turns on for one scan upon completion of the instruction<br>When the instruction completes with an error, (d2)+1 also turns on. | —                          | Bit                    | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      |           | Execution condition                                                                                                                         | —                          | Bit                    | BOOL                                    |
| ENO     |           | Execution result                                                                                                                            | —                          | Bit                    | BOOL                                    |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

| Operand |           | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|-----------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|------------|
|         |           | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | GP.SOCRCV | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | ○        | — | ○  | ○          |
|         | SP.SOCRCV | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | ○  | ○          |
| (s1)    | GP.SOCRCV | ○                                | —   | ○                                     | —         | — | —           | —  | ○                      | ○        | — | —  | —          |
|         | SP.SOCRCV | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | ○        | — | —  | —          |
| (s2)    |           | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —          |
| (d1)    |           | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —          |
| (d2)    |           | ○                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —          |

## ■Control data

| Operand: (s2) |                   |                                                                                                                                                                    |               |        |
|---------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item              | Description                                                                                                                                                        | Setting range | Set by |
| +0            | System area       | —                                                                                                                                                                  | —             | —      |
| +1            | Completion status | The completion status is stored upon completion of the instruction.<br>• 0000H: Completed successfully<br>• Other than 0000H: Completed with an error (error code) | —             | System |

| Operand: (d1) |                     |                                                                                                                          |               |        |
|---------------|---------------------|--------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item                | Description                                                                                                              | Setting range | Set by |
| +0            | Receive data length | The length of the data read from the socket communications receive data area is stored.<br>(Number of bytes)             | 0 to 10238    | System |
| +1 to +□      | Receive data        | The data read from the socket communications receive data area is stored sequentially in ascending order of addresses.*1 | —             | System |

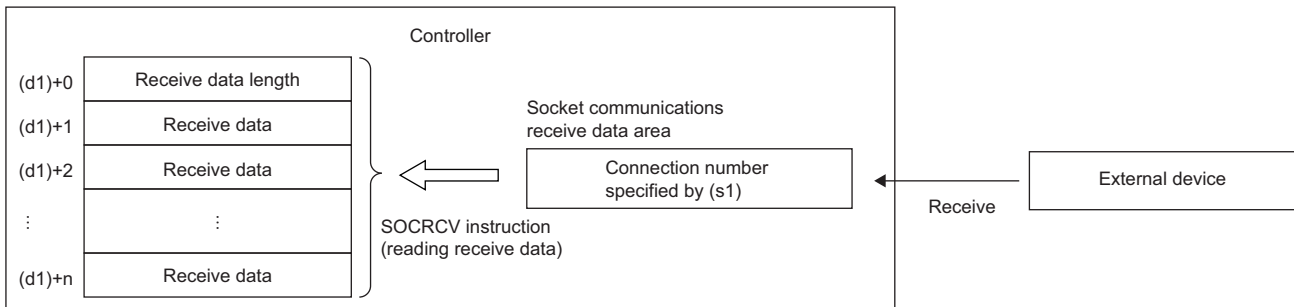
\*1 The received data is stored in units of bytes sequentially from lower bytes. When an odd number of bytes of data is received, the last receive data is stored in the lower byte of the last data storage area.

### Point

- When this instruction is executed, receive data is read from the socket communications receive data area during END processing. For this reason, executing this instruction prolongs the scan time.
- When an odd number of bytes of data is received, invalid data is stored in the upper byte of the device where the last receive data is stored.

## Processing details

- This instruction reads the receive data of the connection specified by (s1) from the socket communications receive data area (where the data received from an external device in each connection is stored) by the END processing after the instruction execution.



- The execution status and the completion status of this instruction can be checked with the completion device (d2) specified by the setup data and the completion status indication device (d2)+1.

- Completion device (d2)

This device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

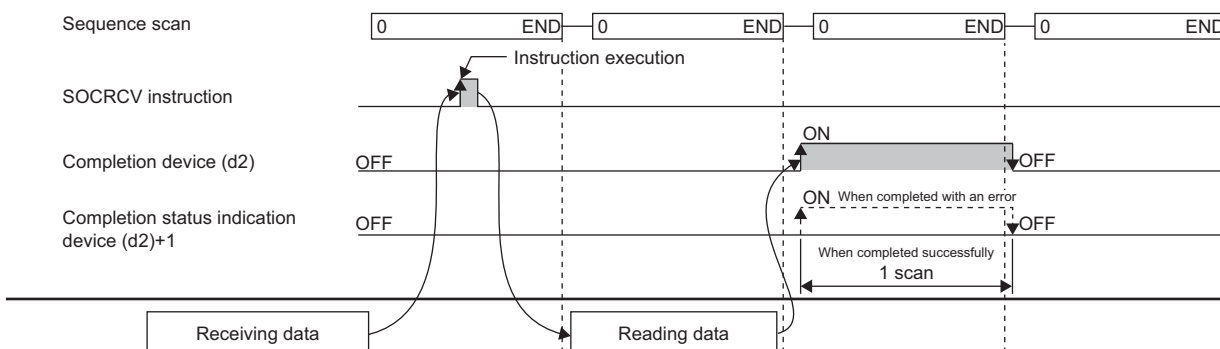
- Completion status indication device (d2)+1

This device turns on or off depending on the completion status of this instruction.

Completed successfully: The device remains off.

Completed with an error: The device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

- The following figure shows the execution timing of this instruction.



### Point

This instruction supports the encrypted predefined protocols (TLS and DTLS). For more details, check the user's manual for the controller used.

## Precautions

When reading receive data from the same connection, do not use this command together with the SOCRCVS instruction.

## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port. |
| 3285H            | The connection number specified by (s1) is outside the range.                           |

Upon completion with an error, the completion status indication device (d2)+1 is turned on and an error code is stored in the completion status (s2)+1.

For the error code stored in the completion status (s2)+1, refer to the following.

📖 User's manual for the controller used

- 
- To avoid receiving too much amount of data, the SOCRMODE instruction can be used to set the size of receive data to limit the amount of receive data.
  - By connecting the completion device of this instruction to the execution instruction through a normally closed contact, data can be read continuously even when it is received continuously.
-

# Reading receive data when the instruction is executed

29

## G.SOCRCVS, S.SOCRCVS

This instruction reads the receive data of the specified connection from the socket communications receive data area.

| Ladder | ST                                                             |
|--------|----------------------------------------------------------------|
|        | <pre>ENO:=G_SOCRCVS(EN,U,s,d); ENO:=S_SOCRCVS(EN,U,s,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction            | Execution condition |
|------------------------|---------------------|
| G.SOCRCVS<br>S.SOCRCVS |                     |

### Setting data

### Description, range, data type

| Operand |           | Description                                                                          | Range   | Data type              | Data type (label)   |
|---------|-----------|--------------------------------------------------------------------------------------|---------|------------------------|---------------------|
| (U)     | G.SOCRCVS | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number) | 3E0H    | 16-bit unsigned binary | ANY16               |
|         | S.SOCRCVS | Dummy                                                                                | —       | String                 | ANYSTRING_SINGLE    |
| (s)     |           | Connection number                                                                    | 1 to 32 | 16-bit unsigned binary | ANY16               |
| (d)     | G.SOCRCVS | Start device for storing the receive data                                            | —       | Device                 | ANY16* <sup>1</sup> |
|         | S.SOCRCVS |                                                                                      |         | Word                   |                     |
| EN      |           | Execution condition                                                                  | —       | Bit                    | BOOL                |
| ENO     |           | Execution result                                                                     | —       | Bit                    | BOOL                |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### Applicable devices

| Operand |           | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |   |    | Others (U) |
|---------|-----------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|---|----|------------|
|         |           | X, Y, M, L, SM, F, B, SB, FX, FY | J□\□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K        | H | E | \$ |            |
| (U)     | G.SOCRCVS | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | — | —  | ○          |
|         | S.SOCRCVS | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○ | ○  |            |
| (s)     | G.SOCRCVS | ○                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | — | —  |            |
|         | S.SOCRCVS | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | — | —  |            |
| (d)     |           | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | — | —  |            |

## Control data

| Operand: (d) |                     |                                                                                                                          |               |        |
|--------------|---------------------|--------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device       | Item                | Description                                                                                                              | Setting range | Set by |
| +0           | Receive data length | The length of the data read from the socket communications receive data area is stored.<br>(Number of bytes)             | 0 to 10238    | System |
| +1 to +□     | Receive data        | The data read from the socket communications receive data area is stored sequentially in ascending order of addresses.*1 | —             | System |

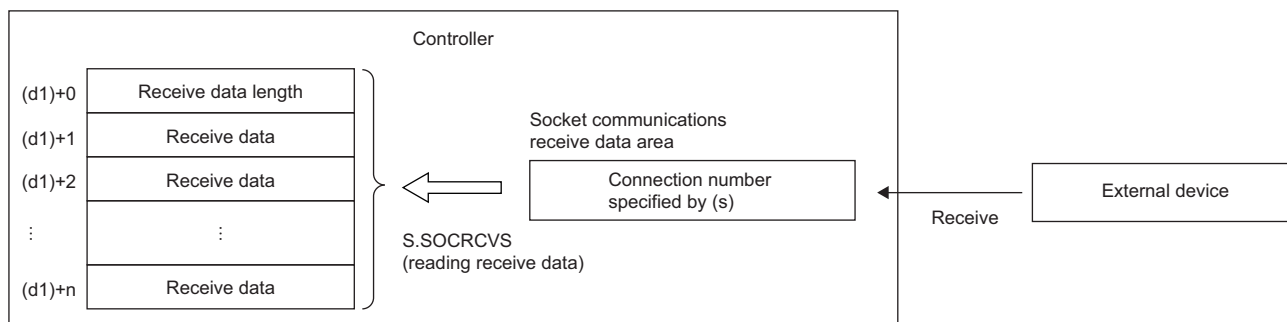
\*1 The received data is stored in units of bytes sequentially from lower bytes. When an odd number of bytes of data is received, the last receive data is stored in the lower byte of the last data storage area.

### Point

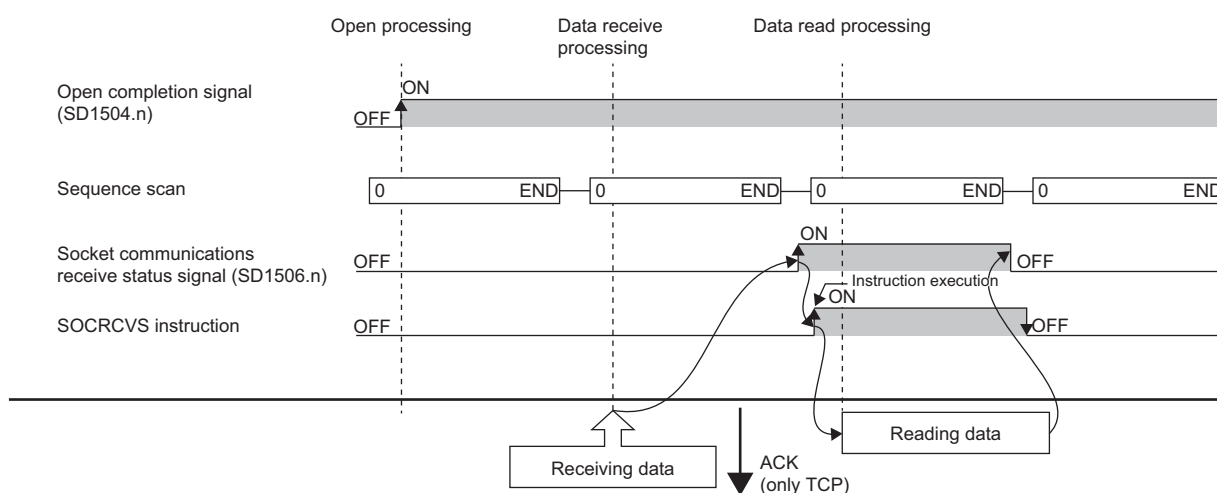
- The default receive data size is 2046 bytes. To receive 2047 bytes of data or more, change the receive data size using the SOCRMODE instruction.
- When an odd number of bytes of data is received, invalid data is stored in the upper byte of the device where the last receive data is stored.

## Processing details

- The S.SOCRCVS instruction reads the receive data of the connection specified by (s) from the socket communications receive data area (where the data received from an external device in each connection is stored).



- The following figure shows the timing of receive processing using this instruction.



### Point

This instruction supports the encrypted predefined protocols (TLS and DTLS). For more details, check the user's manual for the controller used.



## Precautions

When reading receive data from the same connection, do not use this command together with the SOCRCV instruction.

## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port. |
| 3285H            | The connection number specified by (s) is outside the range.                            |

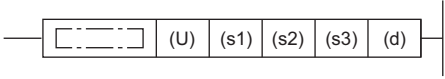
### Point

To avoid receiving too much amount of data, the SOCRMODE instruction can be used to set the size of receive data to limit the amount of receive data.

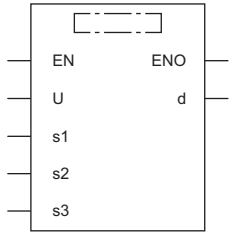
# Sending data

## GP.SOCSND, SP.SOCSND

This instruction sends the data to the external device of the specified connection.

| Ladder                                                                            | ST                                                                           |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------|
|  | <pre>ENO:=GP_SOCSND(EN,U,s1,s2,s3,d); ENO:=SP_SOCSND(EN,U,s1,s2,s3,d);</pre> |

### FBD/LD



### ■Execution condition

| Instruction            | Execution condition                                                               |
|------------------------|-----------------------------------------------------------------------------------|
| GP.SOCSND<br>SP.SOCSND |  |

## Setting data

### ■Description, range, data type

| Operand |           | Description                                                                                                                                | Range                      | Data type              | Data type (label)                       |
|---------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------|-----------------------------------------|
| (U)     | GP.SOCSND | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number)                                                       | 3E0H                       | 16-bit unsigned binary | ANY16                                   |
|         | SP.SOCSND | Dummy                                                                                                                                      | —                          | String                 | ANYSTRING_SINGLE                        |
| (s1)    |           | Connection number                                                                                                                          | 1 to 32                    | 16-bit unsigned binary | ANY16                                   |
| (s2)    | GP.SOCSND | Start device where control data is stored                                                                                                  | Refer to the control data. | Device                 | ANY16                                   |
|         | SP.SOCSND |                                                                                                                                            |                            | Word                   | ANY16_ARRAY<br>(Number of elements: 2)  |
| (s3)    | GP.SOCSND | Start device for storing the send data                                                                                                     | —                          | Device                 | ANY16* <sup>1</sup>                     |
|         | SP.SOCSND |                                                                                                                                            |                            | Word                   |                                         |
| (d)     |           | Device that turns on for one scan upon completion of the instruction<br>When the instruction completes with an error, (d)+1 also turns on. | —                          | Bit                    | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      |           | Execution condition                                                                                                                        | —                          | Bit                    | BOOL                                    |
| ENO     |           | Execution result                                                                                                                           | —                          | Bit                    | BOOL                                    |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

### ■Applicable devices

| Operand |           | Bit                              |     | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    |   | Others (U) |
|---------|-----------|----------------------------------|-----|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|---|------------|
|         |           | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |            |
| (U)     | GP.SOCSND | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | ○ |            |
|         | SP.SOCSND | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | ○ |            |
| (s1)    | GP.SOCSND | ○                                | —   | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | — |            |
|         | SP.SOCSND | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | — |            |
| (s2)    |           | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | — |            |
| (s3)    |           | —                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | — |            |
| (d)     |           | ○                                | —   | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | — |            |

### ■Control data

| Operand: (s2) |                   |                                                                                                                                                                    |               |        |
|---------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item              | Description                                                                                                                                                        | Setting range | Set by |
| +0            | System area       | —                                                                                                                                                                  | —             | —      |
| +1            | Completion status | The completion status is stored upon completion of the instruction.<br>• 0000H: Completed successfully<br>• Other than 0000H: Completed with an error (error code) | —             | System |

| Operand: (s3) |                  |                                                 |               |        |
|---------------|------------------|-------------------------------------------------|---------------|--------|
| Device        | Item             | Description                                     | Setting range | Set by |
| +0            | Send data length | Specify the send data length. (Number of bytes) | 1 to 10238    | User   |
| +1 to +□      | Send data        | Specify the send data.* <sup>1</sup>            | —             | User   |

\*1 The send data is sent in units of bytes sequentially from lower bytes. When an odd number of bytes of data is sent, store the last send data in the lower byte of the last data storage area.

#### Point

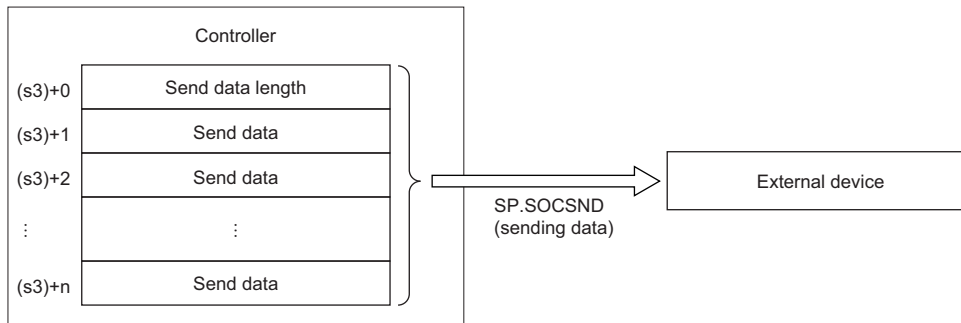
When TCP is used, the send data length should be equal to or less than the maximum window size (receive buffer) of the external device.

When TLS is used, the length of send data before encrypted should be equal to or less than the maximum window size (receive buffer) of the external device.

Data which exceeds the maximum window size of the external device cannot be sent.

## Processing details

- Sends the data in the device specified by (s3) to the external device of the connection specified by (s1).



- The execution status and the completion status of this instruction can be checked with the completion device (d) specified by the setup data and the completion status indication device (d)+1.

- Completion device (d)

This device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

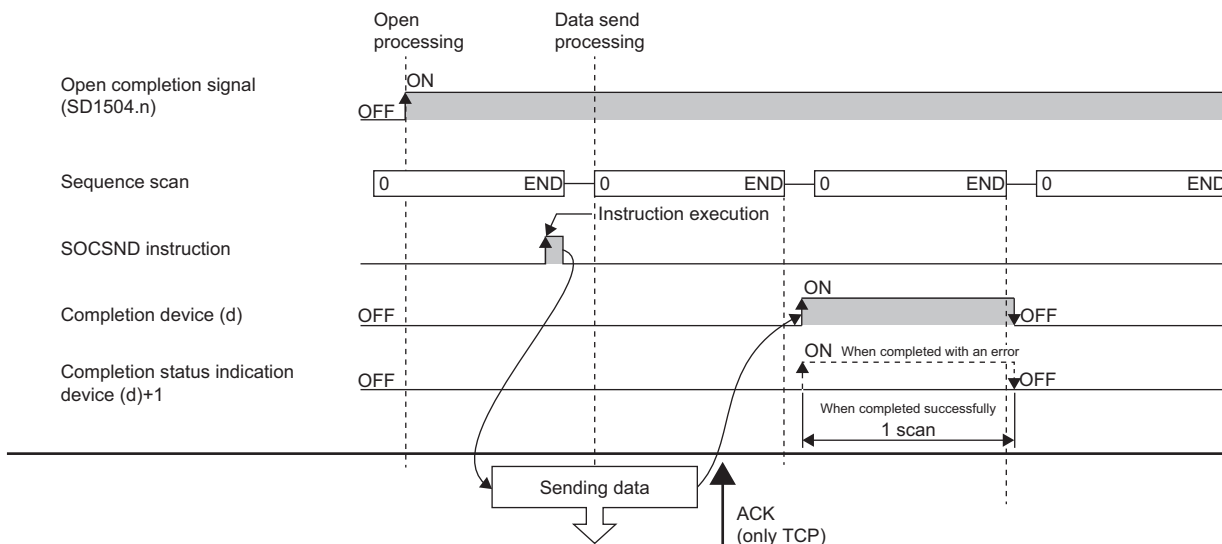
- Completion status indication device (d)+1

This device turns on or off depending on the completion status of this instruction.

Completed successfully: The device remains off.

Completed with an error: The device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

- The following figure shows the timing of send processing using this instruction.



Even after the completion device turns on, data may be sent continuously. Check the completion of the send processing on the receiving side.

## Precautions

Create a means of arrival check on both the own station and the external device to check that the send data arrives at the external device and data transmission is completed successfully after the instruction is executed.

If a connection is established with the external device by using TCP/IP or TLS protocol, and then this instruction is executed to send data to the external device, the execution of this instruction is completed without checking the arrival of that data at the external device, and the completion status ((S2)+1) becomes completed successfully.

For example, create a program that notifies the external device when data was successfully sent, to notify the external device of arrival.

## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port. |
| 3285H            | The connection number specified by (s1) is outside the range.                           |
| 3293H            | The length of send data specified by (s3) is outside the range.                         |

Upon completion with an error, the completion status indication device (d)+1 is turned on and an error code is stored in the completion status (s2)+1.

For the error code stored in the completion status (s2)+1, refer to the following.

 User's manual for the controller used

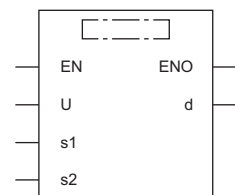
# Reading connection information

## GP.SOCCINF, SP.SOCCINF

This instruction reads the connection information of the connection specified by (s1) and stores it in the device specified by (d) and later.

| Ladder | ST                                                                       |
|--------|--------------------------------------------------------------------------|
|        | <pre>ENO:=GP_SOCCINF(EN,U,s1,s2,d); ENO:=SP_SOCCINF(EN,U,s1,s2,d);</pre> |

## FBD/LD



## Execution condition

| Instruction              | Execution condition |
|--------------------------|---------------------|
| GP.SOCCINF<br>SP.SOCCINF |                     |

## Setting data

## Description, range, data type

| Operand |            | Description                                                                          | Range                      | Data type              | Data type (label)                      |
|---------|------------|--------------------------------------------------------------------------------------|----------------------------|------------------------|----------------------------------------|
| (U)     | GP.SOCCINF | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number) | 3E0H                       | 16-bit unsigned binary | ANY16                                  |
|         | SP.SOCCINF | Dummy                                                                                | —                          | String                 | ANYSTRING_SINGLE                       |
| (s1)    |            | Connection number                                                                    | 1 to 32                    | 16-bit unsigned binary | ANY16                                  |
| (s2)    | GP.SOCCINF | Start device where control data is stored                                            | Refer to the control data. | Device                 | ANY16                                  |
|         | SP.SOCCINF |                                                                                      |                            | Word                   | ANY16_ARRAY<br>(Number of elements: 2) |
| (d)     |            | Head device for storing connection information                                       | —                          | Word                   | ANY16_ARRAY<br>(Number of elements: 5) |
| EN      |            | Execution condition                                                                  | —                          | Bit                    | BOOL                                   |
| ENO     |            | Execution result                                                                     | —                          | Bit                    | BOOL                                   |

## Applicable devices

| Operand |            | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    |   | Others (U) |
|---------|------------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|---|------------|
|         |            | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |            |
| (U)     | GP.SOCCINF | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | ○ | ○          |
|         | SP.SOCCINF | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | ○ |            |
| (s1)    | GP.SOCCINF | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | — | —          |
|         | SP.SOCCINF | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | — | —          |
| (s2)    |            | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | — | —          |
| (d)     |            | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | — | —          |

## ■Control data

| Operand: (s2) |                   |                                                                                                                                                                    |               |        |
|---------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item              | Description                                                                                                                                                        | Setting range | Set by |
| +0            | System area       | —                                                                                                                                                                  | —             | —      |
| +1            | Completion status | The completion status is stored upon completion of the instruction.<br>• 0000H: Completed successfully<br>• Other than 0000H: Completed with an error (error code) | —             | System |

| Operand: (d) |                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                      |        |
|--------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|--------|
| Device       | Item                          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Setting range                                                                                        | Set by |
| +0<br>+1     | IP address of external device | Store the IP address of an external device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 00000001H to FFFFFFFFH<br>00000000H: No communication destination (FFFFFFFH: simultaneous broadcast) | System |
| +2           | Destination port number       | Store the destination port number of an external device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0001H to FFFFH (FFFFH: Simultaneous broadcast)                                                       | System |
| +3           | Own station port number.      | Store the own station port number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0001H to 1387H<br>1392H to FFFE H                                                                    | System |
| +4           | Connection use application    | Store the usage of a connection. <div><div><div>b15 b14 ... b10 b9 b8 b7 ... b0</div><div>(d)+4<div><div>(3)</div><div>0</div><div>(4)</div><div>(2)</div><div>(1)</div><div>0</div></div></div></div><div>(1) Communication method (protocol) (b8 and 7)<ul style="list-style-type: none"><li>• 00: TCP</li><li>• 01: TLS</li><li>• 10: UDP</li><li>• 11: DTLS</li></ul><div>(2) Socket communications function procedure (b9)<ul style="list-style-type: none"><li>• 1: No procedure (fixed)</li></ul><div>(3) Open method (b15, b14)<ul style="list-style-type: none"><li>• 00: Active open or UDP</li><li>• 10: Unpassive open</li><li>• 11: Fullpassive open</li></ul><div>(4) Predefined protocol setting (b10)<ul style="list-style-type: none"><li>• 0: Do not use the predefined protocol support function. (Use the socket communications function.)</li><li>• 1: Use the predefined protocol support function.</li></ul></div></div></div></div></div> | —                                                                                                    | System |

## Processing details

Reads the connection information of the connection specified by (s1).

### Point

This instruction supports the encrypted predefined protocols (TLS and DTLS). For more details, check the user's manual for the controller used.

In TCP/TLS/DTLS Passive mode, if this instruction is executed when connection is open and a connection with the external device is not established, data other than information of the external device is stored as follows. In addition, when connection is not open, 0H is stored.

| Device     | Item                          | Data to be stored                                                             |                        |
|------------|-------------------------------|-------------------------------------------------------------------------------|------------------------|
|            |                               | Connection is open but connection with the external device is not established | Connection is not open |
| d+0<br>d+1 | IP address of external device | 00000000H                                                                     | 00000000H              |
| d+2        | Destination port number       | 0000H                                                                         | 0000H                  |
| d+3        | Own station port number       | Data when connection is open                                                  | 0000H                  |
| d+4        | Connection use application    | Data when connection is open                                                  | 0000H                  |

## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port. |
| 3285H            | The connection number specified by (s1) is outside the range.                           |

When completed with an error, an error code is stored in the completion status (s2)+1.

For the error code stored in the completion status (s2)+1, refer to the following.

 User's manual for the controller used



# Changing the communication target (UDP/IP)

29

## GP.SOCCSET, SP.SOCCSET

This instruction changes the communication target IP address and port number of the specified connection.

| Ladder | ST                                                                   |
|--------|----------------------------------------------------------------------|
|        | <pre>ENO:=GP_SOCCSET(EN,U,s1,s2); ENO:=SP_SOCCSET(EN,U,s1,s2);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction              | Execution condition |
|--------------------------|---------------------|
| GP.SOCCSET<br>SP.SOCCSET |                     |

### Setting data

#### Description, range, data type

| Operand |            | Description                                                                          | Range                      | Data type              | Data type (label)                      |
|---------|------------|--------------------------------------------------------------------------------------|----------------------------|------------------------|----------------------------------------|
| (U)     | GP.SOCCSET | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number) | 3E0H                       | 16-bit unsigned binary | ANY16                                  |
|         | SP.SOCCSET | Dummy                                                                                | —                          | String                 | ANYSTRING_SINGLE                       |
| (s1)    |            | Connection number                                                                    | 1 to 32                    | 16-bit unsigned binary | ANY16                                  |
| (s2)    | GP.SOCCSET | Start device where control data is stored                                            | Refer to the control data. | Device                 | ANY16                                  |
|         | SP.SOCCSET |                                                                                      |                            | Word                   | ANY16_ARRAY<br>(Number of elements: 5) |
| EN      |            | Execution condition                                                                  | —                          | Bit                    | BOOL                                   |
| ENO     |            | Execution result                                                                     | —                          | Bit                    | BOOL                                   |

#### Applicable devices

| Operand |            | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    |   | Others (U) |
|---------|------------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|---|------------|
|         |            | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |   |            |
| (U)     | GP.SOCCSET | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | ○ | ○          |
|         | SP.SOCCSET | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | ○ | ○          |
| (s1)    | GP.SOCCSET | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | — | —          |
|         | SP.SOCCSET | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | — | —          |
| (s2)    |            | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | — | —          |

## ■Control data

| Operand: (s2) |                               |                                                                                                                                                                                                                      |                                                              |        |
|---------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|--------|
| Device        | Item                          | Description                                                                                                                                                                                                          | Setting range                                                | Set by |
| +0            | System area                   | —                                                                                                                                                                                                                    | —                                                            | —      |
| +1            | Completion status             | The completion status is stored upon completion of the instruction. <ul style="list-style-type: none"><li>• 0000H: Completed successfully</li><li>• Other than 0000H: Completed with an error (error code)</li></ul> | —                                                            | System |
| +2<br>+3      | IP address of external device | Store the IP address of an external device.                                                                                                                                                                          | 00000001H to FFFFFFFFH<br>(FFFFFFFH: simultaneous broadcast) | User   |
| +4            | Destination port number       | Store the destination port number of an external device.                                                                                                                                                             | 0001H to FFFFH<br>(FFFFH: simultaneous broadcast)            | User   |

## Processing details

In UDP communications, this instruction changes the communication target IP address and port number of the connection specified by (s1).

### Point

- Using this instruction allows the user to change the communication destination without closing the connection.
- If this instruction is executed while there is data in the receive data area, the instruction is validated after the SOCRCV instruction or SOCRCVS instruction is executed. If this instruction is executed while there is no data in the receive data area, the instruction is validated soon after it is executed.

## Precautions

Do not use this instruction to change the communication destination during execution of the SOCSND instruction.

## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port. |
| 3285H            | The connection number specified by (s1) is outside the range.                           |

When completed with an error, an error code is stored in the completion status (s2)+1.

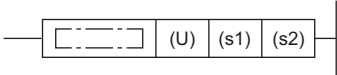
For the error code stored in the completion status (s2)+1, refer to the following.

📖 User's manual for the controller used

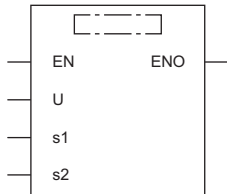
# Changing the receive mode

## GP.SOCRMODE, SP.SOCRMODE

This instruction changes the TCP/TLS receive mode and receive data size for the specified connection (invalid for UDP/DTLS communications connections).

| Ladder                                                                            | ST                                                                     |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------|
|  | <pre>ENO:=GP_SOCRMODE(EN,U,s1,s2); ENO:=SP_SOCRMODE(EN,U,s1,s2);</pre> |

### FBD/LD



### Execution condition

| Instruction                | Execution condition                                                               |
|----------------------------|-----------------------------------------------------------------------------------|
| GP.SOCRMODE<br>SP.SOCRMODE |  |

## Setting data

### ■Description, range, data type

| Operand |             | Description                                                                          | Range                      | Data type              | Data type (label)                      |
|---------|-------------|--------------------------------------------------------------------------------------|----------------------------|------------------------|----------------------------------------|
| (U)     | GP.SOCRMODE | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number) | 3E0H                       | 16-bit unsigned binary | ANY16                                  |
|         | SP.SOCRMODE | Dummy                                                                                | —                          | String                 | ANYSTRING_SINGLE                       |
| (s1)    |             | Connection number                                                                    | 1 to 32                    | 16-bit unsigned binary | ANY16                                  |
| (s2)    | GP.SOCRMODE | Start device where control data is stored                                            | Refer to the control data. | Device                 | ANY16                                  |
|         | SP.SOCRMODE |                                                                                      |                            | Word                   | ANY16_ARRAY<br>(Number of elements: 4) |
| EN      |             | Execution condition                                                                  | —                          | Bit                    | BOOL                                   |
| ENO     |             | Execution result                                                                     | —                          | Bit                    | BOOL                                   |

### ■Applicable devices

| Operand |             | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|-------------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|         |             | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | GP.SOCRMODE | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | ○          |
|         | SP.SOCRMODE | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | ○          |
| (s1)    | GP.SOCRMODE | ○                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —          |
|         | SP.SOCRMODE | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | —          |
| (s2)    |             | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |

### ■Control data

| Operand: (s2) |                                     |                                                                                                                                                                    |               |        |
|---------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item                                | Description                                                                                                                                                        | Setting range | Set by |
| +0            | System area                         | —                                                                                                                                                                  | —             | —      |
| +1            | Completion status                   | The completion status is stored upon completion of the instruction.<br>• 0000H: Completed successfully<br>• Other than 0000H: Completed with an error (error code) | —             | System |
| +2            | TCP /TLS receive mode <sup>*1</sup> | Store the TCP/TLS receive mode.<br>• 0: TCP/TLS standard receive mode<br>• 1: TCP/TLS fixed-length receive mode                                                    | 0, 1          | User   |
| +3            | Receive data size                   | Store the size of socket communications receive data (Number of bytes)                                                                                             | 1 to 10238    | User   |

\*1 This item is invalid for UDP/DTLS communications connections.

## Processing details

- This instruction changes the TCP/TLS receive mode and receive data size for the connection (other than a UDP/DTLS communications connection) specified by (s1).
- For TCP/TLS connections, the function enables the mode specified by (s2)+2.

### Point

This instruction supports the encrypted predefined protocol (TLS). For more details, check the user's manual for the controller used.

### ■TCP/TLS standard receive mode

Upon receipt of data, the instruction stores the data in the socket communications receive data area and turns on SD1506, and SD2132 to SD2135 (socket communications receive status signal).

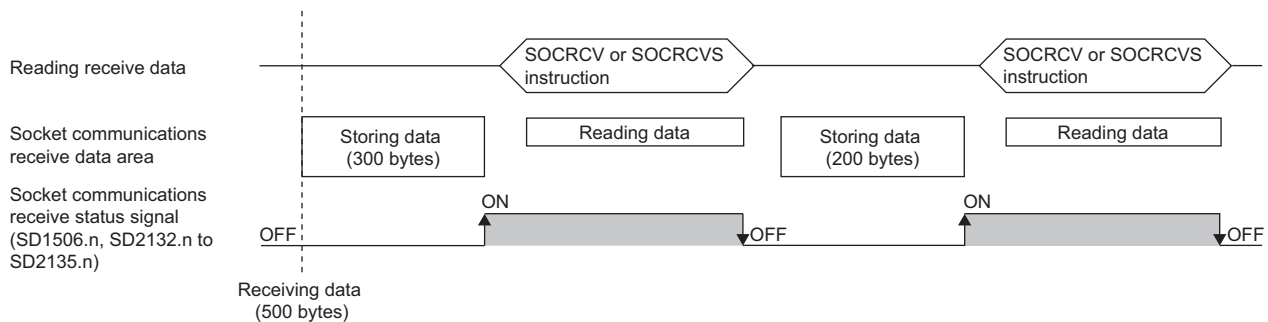
If the received data exceeds the specified receive data size, the excess data becomes the next receive data.

If data is received later before data is read from the socket communications receive data area using the SOCRCV instruction or SOCRCVS instruction, it is stored in the receive data area in the OS.

If the receive data area in the OS contains data when data is read from the socket communications receive data area using the SOCRCV instruction or SOCRCVS instruction, the instruction stores the data in the socket communications receive data area and turns on SD1506 and SD2132 to SD2135 (socket communications receive status signal).

### Ex.

When 500 bytes of data is received while the receive data size is set to 300 bytes



## ■TCP/TLS fixed-length receive mode

Upon receipt of data, the instruction stores the data in the socket communications receive data area. If the specified receive data size is not reached, SD1506 and SD2132 to SD2135 (socket communications receive status signal) does not turn on. Data reception is repeated until the received data reaches the receive data size. When it reaches the receive data size, SD1506 and SD2132 to SD2135 (socket communications receive status signal) turn on.

If the received data exceeds the specified receive data size, the excess data becomes the next receive data.

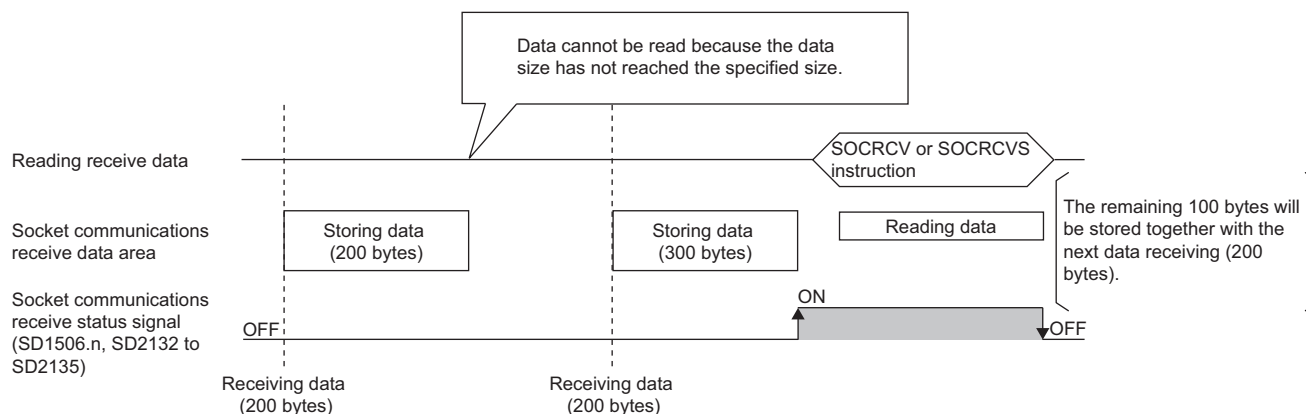
If data is received later before data is read from the socket communications receive data area using the SOCRCV instruction or SOCRCVS instruction, it is stored in the receive data area in the OS.

If the receive data area in the OS contains data when data is read from the socket communications receive data area using the SOCRCV instruction or SOCRCVS instruction, the instruction stores the data in the socket communications receive data area, but does not turn on SD1506 and SD2132 to SD2135 (socket communications receive status signal) if the data has not reached the specified receive data size.

Then data reception is repeated until the received data reaches the receive data size. When it reaches the receive data size, SD1506 and SD2132 to SD2135 (socket communications receive status signal) turn on.

### Ex.

When 200 bytes of data is received continuously while the receive data size is set to 300 bytes



### Point

- Effective use of devices

The receive data storage device used by the SOCRCV instruction or SOCRCVS instruction needs a 5119-word area (10238 bytes). Decreasing the receive data size enables effective use of the device.

- Preventing receive data from being divided

Depending on the line type, data to be received from the external device may be divided before arrival. In this case, specifying the receive data size in TCP/TLS fixed-length receive mode can prevent receive data from being divided.

- Preventing receive data from being connected

Due to a delay in receive processing of the sequence program, data which has been divided and sent may be connected before receiving depending on the external device.

Specifying the receive data size in TCP/TLS fixed-length receive mode enables data to be correctly divided and received.

- The size of the receive data to be read once by the SOCRCV instruction or SOCRCVS instruction is specified in (s2)+3. In the case of UDP/DTLS, if the received data exceeds the specified receive data size, the excess data becomes the next receive data.

## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port. |
| 3285H            | The connection number specified by (s1) is outside the range.                           |

When completed with an error, an error code is stored in the completion status (s2)+1.

For the error code stored in the completion status (s2)+1, refer to the following.

 User's manual for the controller used

### Point

When the receive status signal does not turn on in TCP/TLS fixed-length receive mode, the data received as of the current time can be read with the SOCRDATA instruction to check whether the data sent from the external device is missing.

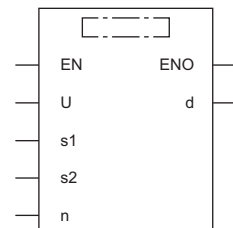
# Reading socket communications receive data

## G(P).SOCRDATA, S(P).SOCRDATA

These instructions read data by the number of words specified by (n) from the socket communications receive data area of the connection specified by (s1), and store them in the device specified by (d) and later.

| Ladder | ST                                                                                                                                                 |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------|
|        | <pre> ENO:=G_SOCRDATA(EN,U,s1,s2,n,d); ENO:=GP_SOCRDATA(EN,U,s1,s2,n,d); ENO:=S_SOCRDATA(EN,U,s1,s2,n,d); ENO:=SP_SOCRDATA(EN,U,s1,s2,n,d); </pre> |

## FBD/LD



## Execution condition

| Instruction                | Execution condition |
|----------------------------|---------------------|
| G.SOCRDATA<br>S.SOCRDATA   |                     |
| GP.SOCRDATA<br>SP.SOCRDATA |                     |

## Setting data

## Descriptions, ranges, and data types

| Operand | Description                                                                                           | Range                      | Data type              | Data type (label)                      |
|---------|-------------------------------------------------------------------------------------------------------|----------------------------|------------------------|----------------------------------------|
| (U)     | G(P).SOCRDATA<br>Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number) | 3E0H                       | 16-bit unsigned binary | ANY16                                  |
|         | S(P).SOCRDATA<br>Dummy                                                                                | —                          | String                 | ANYSTRING_SINGLE                       |
| (s1)    | Connection number                                                                                     | 1 to 32                    | 16-bit unsigned binary | ANY16                                  |
| (s2)    | G(P).SOCRDATA<br>Start device where control data is stored                                            | Refer to the control data. | Device                 | ANY16                                  |
|         | S(P).SOCRDATA                                                                                         |                            | Word                   | ANY16_ARRAY<br>(Number of elements: 2) |
| (d)     | Head device for storing the data that has been read                                                   | —                          | Word                   | ANY16 <sup>*1</sup>                    |
| (n)     | Number of read data                                                                                   | 1 to 5120                  | 16-bit unsigned binary | ANY16                                  |
| EN      | Execution condition                                                                                   | —                          | Bit                    | BOOL                                   |
| ENO     | Execution result                                                                                      | —                          | Bit                    | BOOL                                   |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.



## ■Applicable devices

| Operand |               | Bit                              |     | Word                                  |           |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|---------------|----------------------------------|-----|---------------------------------------|-----------|---|-------------|----|------------------------|----------|---|----|------------|
|         |               | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | G(P).SOCRDATA | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | ○        | — | —  | ○          |
|         | S(P).SOCRDATA | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | ○  | ○          |
| (s1)    | G(P).SOCRDATA | ○                                | —   | ○                                     | —         | — | —           | —  | ○                      | ○        | — | —  | —          |
|         | S(P).SOCRDATA | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | ○        | — | —  | —          |
| (s2)    |               | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —          |
| (d)     |               | —                                | —   | ○                                     | —         | — | —           | —  | ○                      | —        | — | —  | —          |
| (n)     |               | ○                                | —   | ○                                     | —         | — | —           | —  | ○                      | ○        | — | —  | —          |

## ■Control data

| Operand: (s2) |                   |                                                                                                                                                                    |               |        |
|---------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item              | Description                                                                                                                                                        | Setting range | Set by |
| +0            | System area       | —                                                                                                                                                                  | —             | —      |
| +1            | Completion status | The completion status is stored upon completion of the instruction.<br>• 0000H: Completed successfully<br>• Other than 0000H: Completed with an error (error code) | —             | System |

## Processing details

These instructions read data by the number of words specified by (n) from the socket communications receive data area of the connection specified by (s1), and store them in the device specified by (d) and later. If the read data (n) is 0, no processing is performed.

### Point

- This instruction supports the encrypted predefined protocols (TLS and DTLS). For more details, check the user's manual for the controller used.
- The receive data length can be read by setting the number of read data to 1 word. As a result, the device for storing receive data when the SOCRCV instruction or SOCRCVS instruction is executed can be changed.
- After issuing this instruction to check the data to be received this time and issuing the SOCRCMODE instruction to specify the size of the data to be received next time, the SOCRCV instruction or SOCRCVS instruction can be used to read the data of this time. As a result, based on the data received this time, the size of data to be received next can be specified.

## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port. |
| 3285H            | The connection number specified by (s1) is outside the range.                           |
| 3293H            | When the number of read data specified by (n) exceeds the maximum range.                |

When completed with an error, an error code is stored in the completion status (s2)+1.

For the error code stored in the completion status (s2)+1, refer to the following.

📖 User's manual for the controller used

# 29.3      Predefined Protocol Support Function Instruction

## Point

For connections where any of the following instructions is being executed, a request is ignored even if the following multiple instructions are attempted to be executed.

At this time, as long as the execution conditions of the instruction executed later are met, the request is executed after the first instruction being executed completes. SM699 (Dedicated instruction skip flag) turns on while the request is ignored.

- SOCOPEN instruction
- SOCCLOSE instruction
- SOCSND instruction
- SOCRCV instruction
- ECPRTCL instruction

## Executing the registered protocols

### GP.ECPRTCL, SP.ECPRTCL

This instruction executes the protocol registered using the engineering tool.

| Ladder | ST                                                                             |
|--------|--------------------------------------------------------------------------------|
|        | <pre>ENO:=GP_ECPRTCL(EN,U,s1,s2,s3,d); ENO:=SP_ECPRTCL(EN,U,s1,s2,s3,d);</pre> |
| FBD/LD |                                                                                |
|        |                                                                                |

### ■Execution condition

| Instruction              | Execution condition |
|--------------------------|---------------------|
| GP.ECPRTCL<br>SP.ECPRTCL |                     |

## Setting data

### ■Description, range, data type

| Operand |            | Description                                                                                                                                | Range                      | Data type              | Data type (label)                       |
|---------|------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------|-----------------------------------------|
| (U)     | GP.ECPRTCL | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number)                                                       | 3E0H                       | 16-bit unsigned binary | ANY16                                   |
|         | SP.ECPRTCL | Dummy                                                                                                                                      | —                          | String                 | ANYSTRING_SINGLE                        |
| (s1)    |            | Connection number                                                                                                                          | 1 to 32                    | 16-bit unsigned binary | ANY16                                   |
| (s2)    |            | Number of protocols to be executed continuously                                                                                            | 1 to 8                     | 16-bit unsigned binary | ANY16                                   |
| (s3)    | GP.ECPRTCL | Start device where control data is stored                                                                                                  | Refer to the control data. | Device                 | ANY16_ARRAY<br>(Number of elements: 18) |
|         | SP.ECPRTCL |                                                                                                                                            |                            | Word                   | ANY16_ARRAY<br>(Number of elements: 2)  |
| (d)     |            | Device that turns on for one scan upon completion of the instruction<br>When the instruction completes with an error, (d)+1 also turns on. | —                          | Bit                    | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      |            | Execution condition                                                                                                                        | —                          | Bit                    | BOOL                                    |
| ENO     |            | Execution result                                                                                                                           | —                          | Bit                    | BOOL                                    |

### ■Applicable devices

| Operand |            | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |   |    | Others (U) |
|---------|------------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|---|----|------------|
|         |            | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K        | H | E | \$ |            |
| (U)     | GP.ECPRTCL | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | — | —  | ○          |
|         | SP.ECPRTCL | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | — | —  | ○          |
| (s1)    |            | ○                                | —    | ○*1                                   | —           | — | —           | —  | ○*1                    | ○        | — | — | —  | —          |
| (s2)    |            | ○                                | —    | ○*1                                   | —           | — | —           | —  | ○*1                    | ○        | — | — | —  | —          |
| (s3)    | GP.ECPRTCL | —                                | —    | ○*1                                   | —           | — | —           | —  | ○*1                    | —        | — | — | —  | —          |
|         | SP.ECPRTCL | ○                                | —    | ○*1                                   | —           | — | —           | —  | ○*1                    | —        | — | — | —  | —          |
| (d)     |            | ○*1                              | —    | ○                                     | —           | — | —           | —  | ○*1                    | —        | — | — | —  | —          |

\*1 A local device and a file register which is set for each program cannot be used.

## ■Control data

| Operand: (s3) |                                            |                                                                                                                                                                                                                                                                                                                                                                               |               |        |
|---------------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item                                       | Description                                                                                                                                                                                                                                                                                                                                                                   | Setting range | Set by |
| +0            | Resulting number of executed protocols     | The number of protocols executed by this instruction is stored. Any protocol where an error occurred is also included in the execution number. If the setting of setting data or control data contains an error, "0" is stored.                                                                                                                                               | 0, 1 to 8     | System |
| +1            | Completion status                          | The completion status is stored upon completion of the instruction.<br>When two or more protocols are executed, the execution result of the protocol executed last is stored.<br>• 0: Completed successfully<br>• Other than 0: Completed with an error (error code)                                                                                                          | —             | System |
| +2            | Execution protocol number 1                | Specify the number of the protocol to be executed first.                                                                                                                                                                                                                                                                                                                      | 1 to 128      | User   |
| +3            | Execution protocol number 2                | Specify the number of the protocol to be executed second.                                                                                                                                                                                                                                                                                                                     | 0, 1 to 128   | User   |
| +4            | Execution protocol number 3                | Specify the number of the protocol to be executed third.                                                                                                                                                                                                                                                                                                                      | 0, 1 to 128   | User   |
| +5            | Execution protocol number 4                | Specify the number of the protocol to be executed fourth.                                                                                                                                                                                                                                                                                                                     | 0, 1 to 128   | User   |
| +6            | Execution protocol number 5                | Specify the number of the protocol to be executed fifth.                                                                                                                                                                                                                                                                                                                      | 0, 1 to 128   | User   |
| +7            | Execution protocol number 6                | Specify the number of the protocol to be executed sixth.                                                                                                                                                                                                                                                                                                                      | 0, 1 to 128   | User   |
| +8            | Execution protocol number 7                | Specify the number of the protocol to be executed seventh.                                                                                                                                                                                                                                                                                                                    | 0, 1 to 128   | User   |
| +9            | Execution protocol number 8                | Specify the number of the protocol to be executed eighth.                                                                                                                                                                                                                                                                                                                     | 0, 1 to 128   | User   |
| +10           | Collation match<br>Receive packet number 1 | If receiving is included in the communication type of the protocol that has been executed first, the receive packet number successful in collation match is stored. If the communication type is "Send only", "0" is stored. If an error occurs during execution of the first protocol, "0" is stored.                                                                        | 0, 1 to 16    | System |
| +11           | Collation match<br>Receive packet number 2 | If receiving is included in the communication type of the protocol that has been executed second, the receive packet number successful in collation match is stored. If the communication type is "Send only", "0" is stored. If an error occurs during execution of the second protocol, "0" is stored. If the number of protocols executed is less than 2, "0" is stored.   | 0, 1 to 16    | System |
| +12           | Collation match<br>Receive packet number 3 | If receiving is included in the communication type of the protocol that has been executed third, the receive packet number successful in collation match is stored. If the communication type is "Send only", "0" is stored. If an error occurs during execution of the third protocol, "0" is stored. If the number of protocols executed is less than 3, "0" is stored.     | 0, 1 to 16    | System |
| +13           | Collation match<br>Receive packet number 4 | If receiving is included in the communication type of the protocol that has been executed fourth, the receive packet number successful in collation match is stored. If the communication type is "Send only", "0" is stored. If an error occurs during execution of the fourth protocol, "0" is stored. If the number of protocols executed is less than 4, "0" is stored.   | 0, 1 to 16    | System |
| +14           | Collation match<br>Receive packet number 5 | If receiving is included in the communication type of the protocol that has been executed fifth, the receive packet number successful in collation match is stored. If the communication type is "Send only", "0" is stored. If an error occurs during execution of the fifth protocol, "0" is stored. If the number of protocols executed is less than 5, "0" is stored.     | 0, 1 to 16    | System |
| +15           | Collation match<br>Receive packet number 6 | If receiving is included in the communication type of the protocol that has been executed sixth, the receive packet number successful in collation match is stored. If the communication type is "Send only", "0" is stored. If an error occurs during execution of the sixth protocol, "0" is stored. If the number of protocols executed is less than 6, "0" is stored.     | 0, 1 to 16    | System |
| +16           | Collation match<br>Receive packet number 7 | If receiving is included in the communication type of the protocol that has been executed seventh, the receive packet number successful in collation match is stored. If the communication type is "Send only", "0" is stored. If an error occurs during execution of the seventh protocol, "0" is stored. If the number of protocols executed is less than 7, "0" is stored. | 0, 1 to 16    | System |

| Operand: (s3) |                                            |                                                                                                                                                                                                                                                                                                                                                                             |               |        |
|---------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item                                       | Description                                                                                                                                                                                                                                                                                                                                                                 | Setting range | Set by |
| +17           | Collation match<br>Receive packet number 8 | If receiving is included in the communication type of the protocol that has been executed eighth, the receive packet number successful in collation match is stored. If the communication type is "Send only", "0" is stored. If an error occurs during execution of the eighth protocol, "0" is stored. If the number of protocols executed is less than 8, "0" is stored. | 0, 1 to 16    | System |

## Processing details

- This instruction executes the protocol registered using the engineering tool. Using the connection specified by (s1), the instruction executes the protocol in accordance with the control data stored in the device specified by (s3) and later.
- The instruction continuously executes as many protocols as specified by (s2) (a maximum of 8 protocols) at one time.
- The number of executed protocols is stored in the device specified by (s3)+0.
- The protocol execution status can be checked with the predefined protocol support function execution status check area (Un\G350 to Un\G669). (User's manual for the controller used)
- The execution status and the completion status of this instruction can be checked with the completion device (d) specified by the setup data and the completion status indication device (d)+1.
- Completion device (d)

This device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

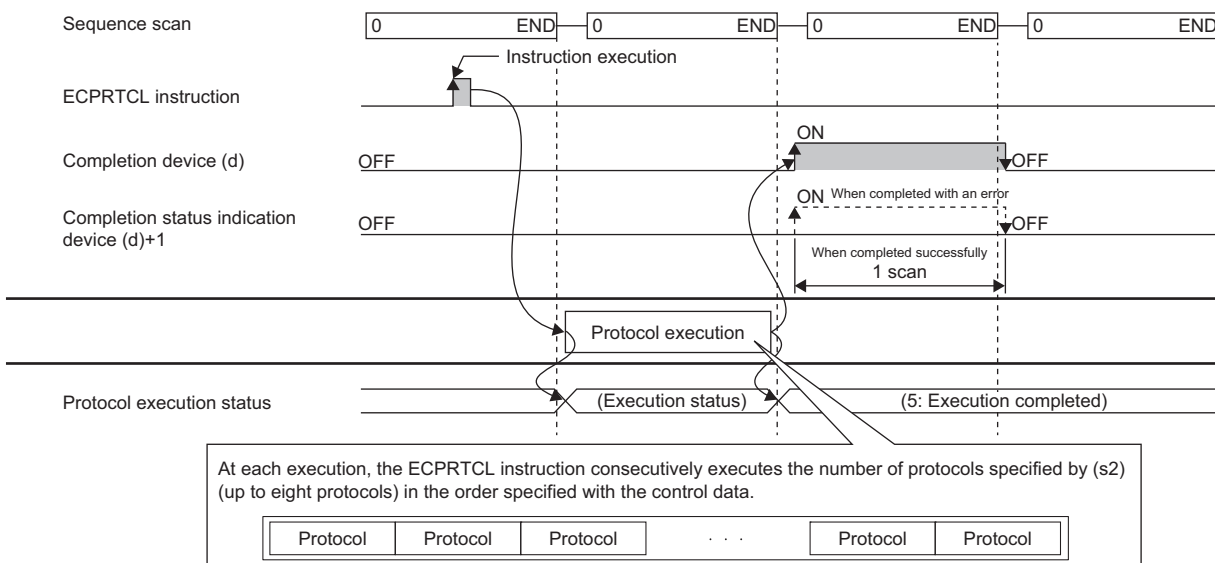
- Completion status indication device (d)+1

This device turns on or off depending on the completion status of this instruction.

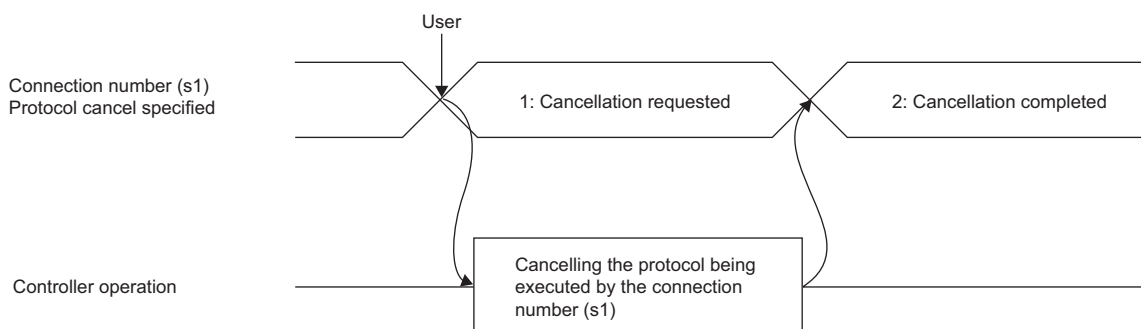
Completed successfully: The device remains off.

Completed with an error: The device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

- The following figure shows the execution timing of this instruction.



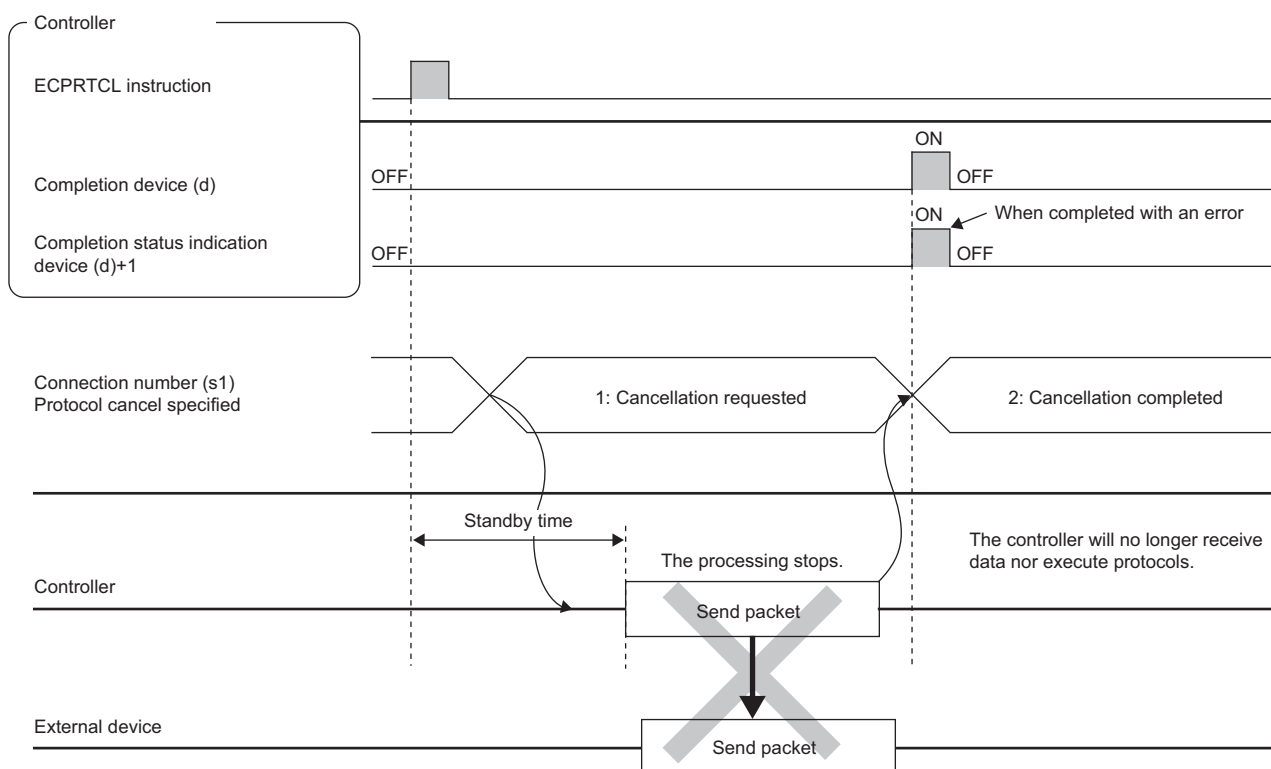
- Protocol execution can be canceled by setting a protocol cancel request. The protocol cancel request is specified in the predefined protocol support function execution status check area (Un\G350 to Un\G669). (📖User's manual for the controller used)



- The following figure shows the protocol cancel operations from time to time.

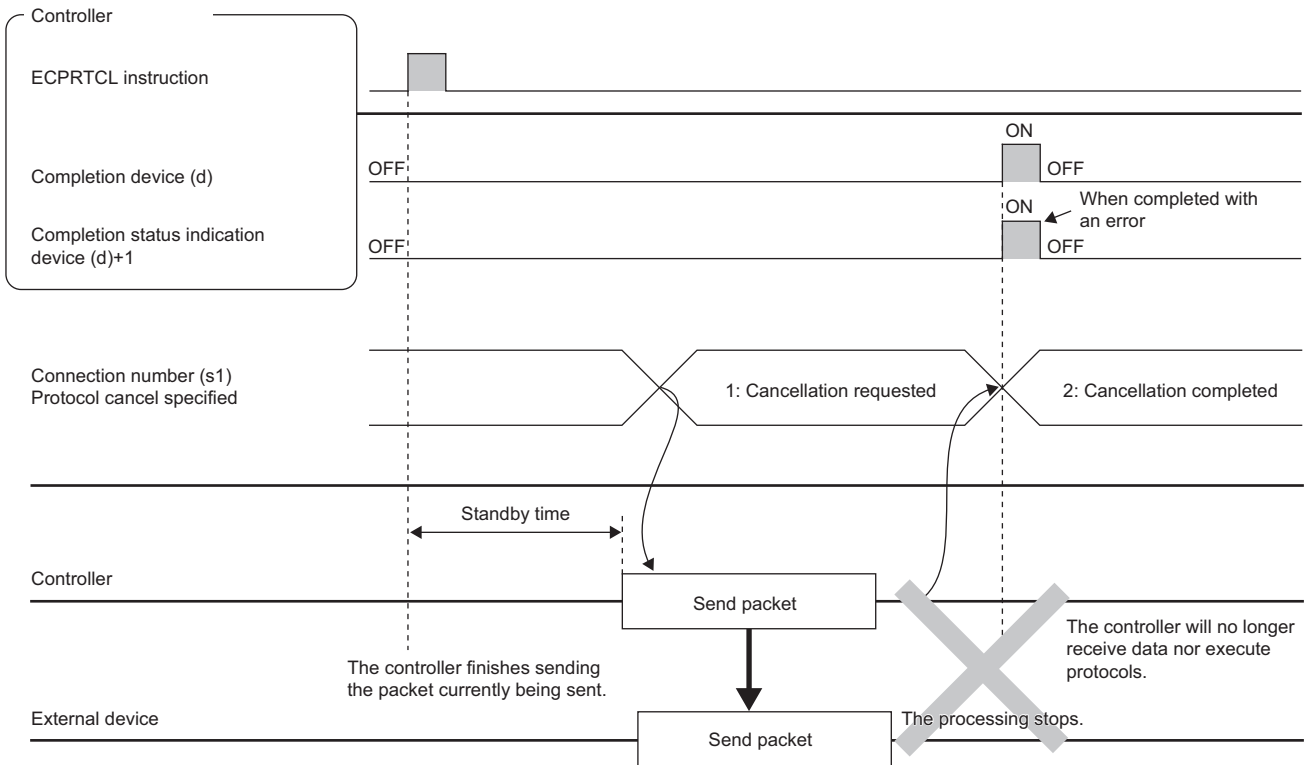
- If a cancel request is issued before transmission

The following figure shows the operation when the protocol execution status is "1: Waiting for transmission".



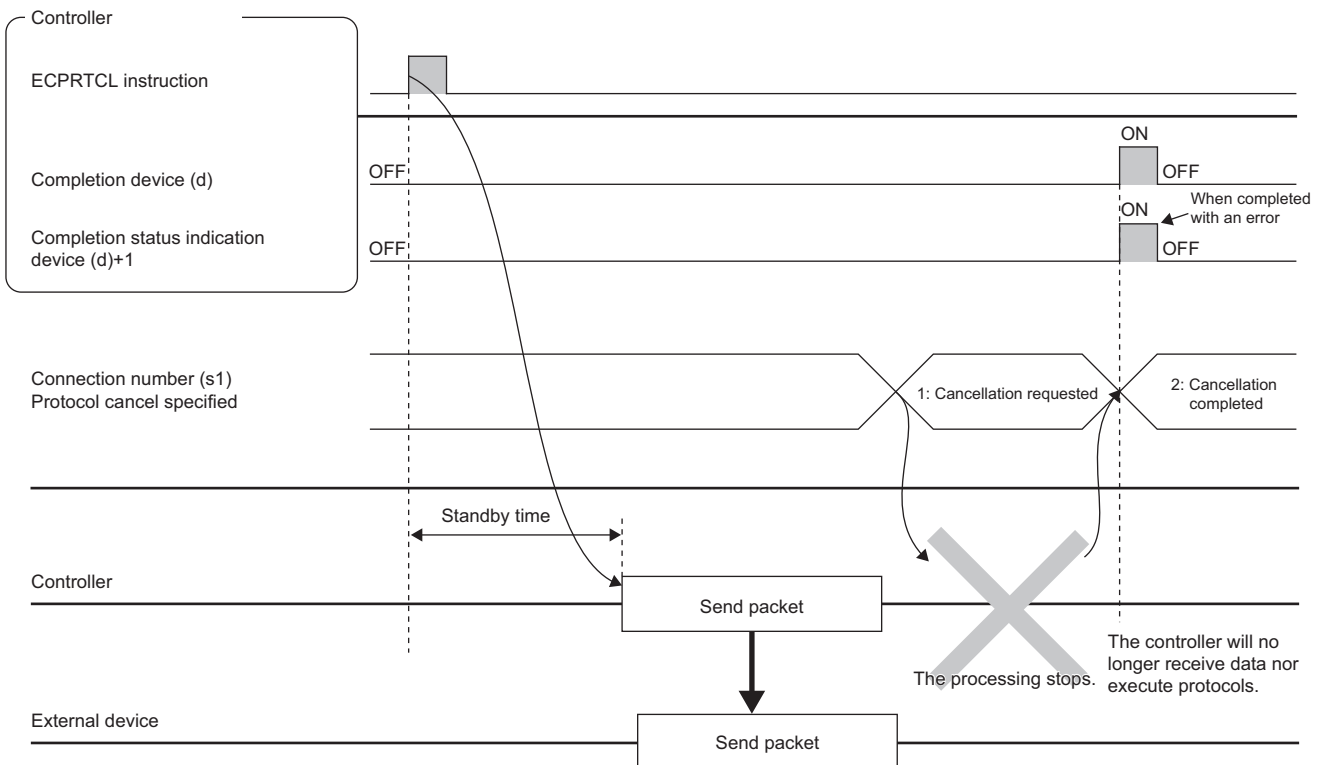
- If a cancel request is issued before completion of transmission

The following figure shows the operation when transmission has not been completed while the protocol execution status is "2: Sending".



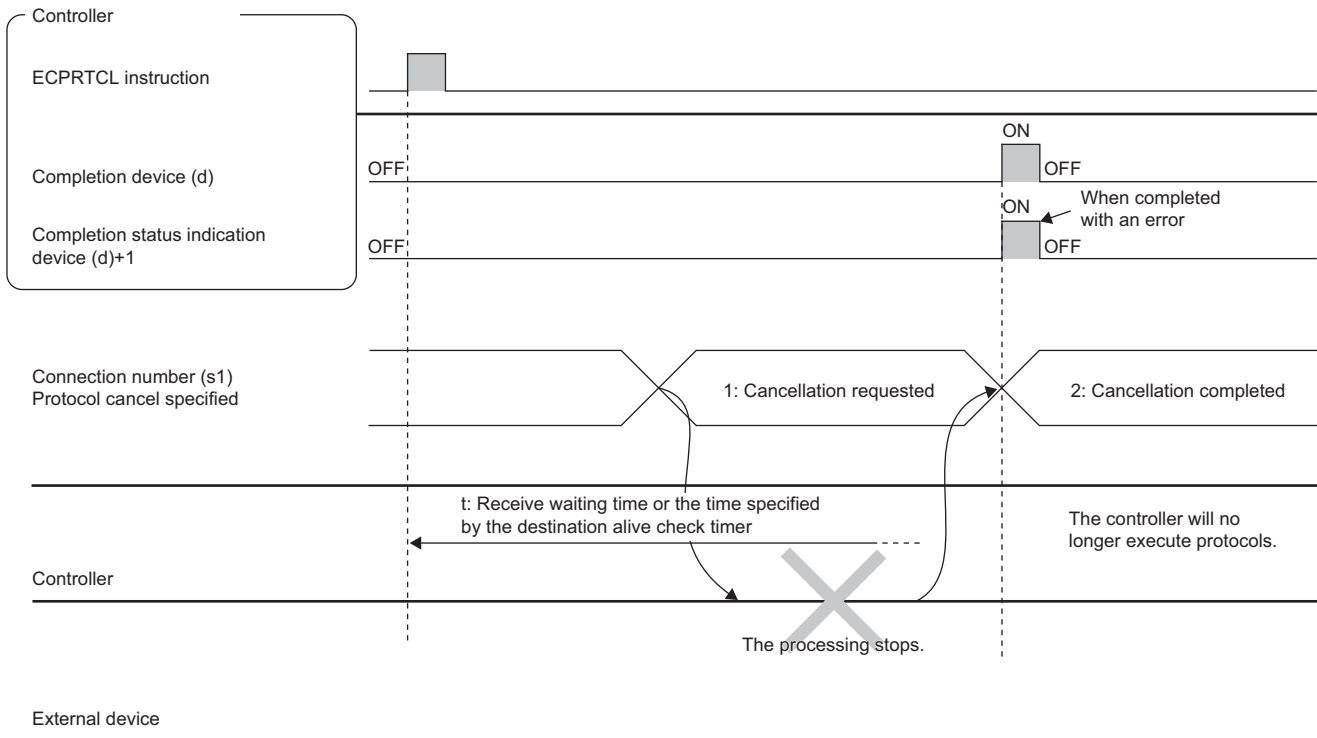
- If a cancel request is issued upon completion of transmission

The following figure shows the operation when transmission has been completed while the protocol execution status is "2: Sending".



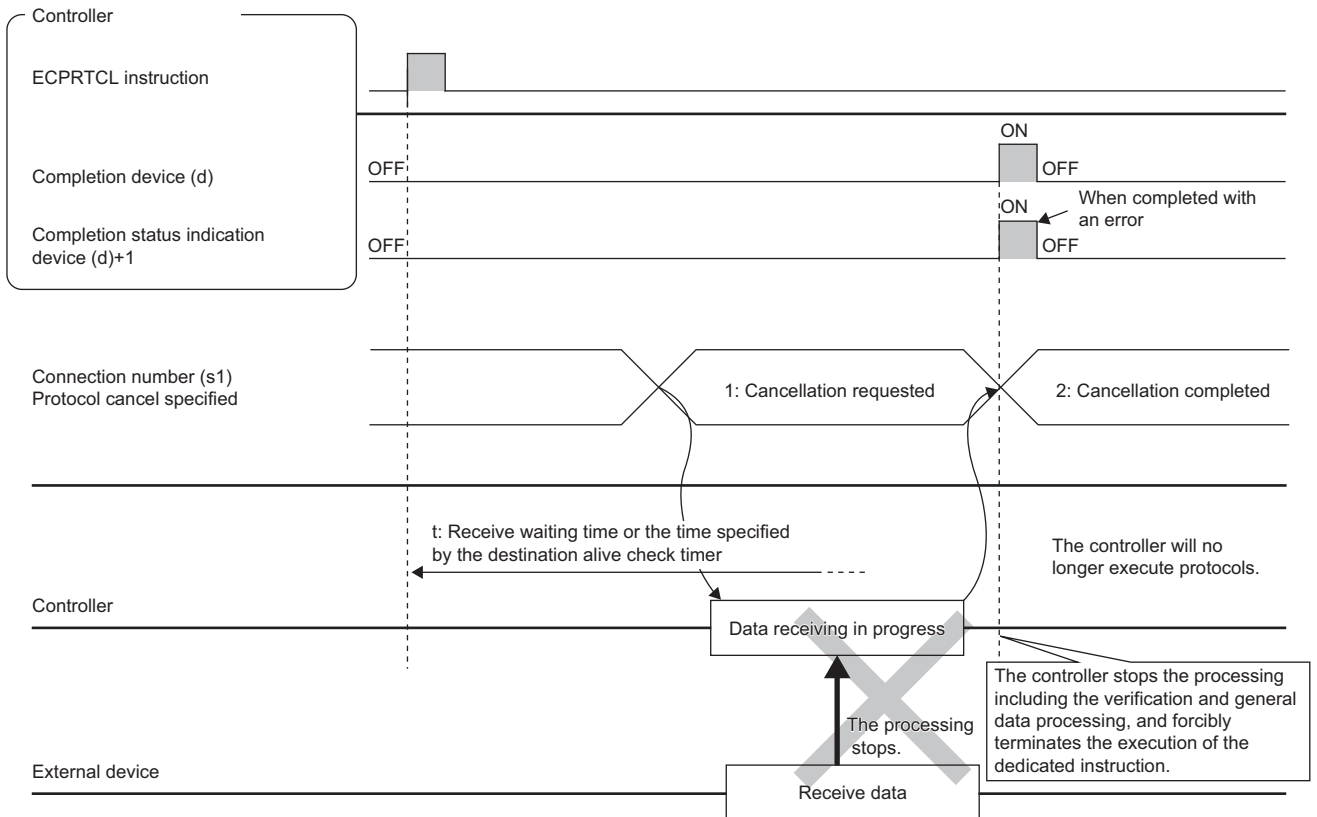
- If a cancel request is issued while waiting for reception

The following figure shows the operation when the protocol execution status is "3: Waiting for data reception".



- If a cancel request is issued during receiving

The following figure shows the operation when the protocol execution status is "4: Receiving".





## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port. |
| 3285H            | (s1) is outside the range.                                                              |

Upon completion with an error, the completion status indication device (d)+1 is turned on and an error code is stored in the completion status (s3)+1.

For the error code stored in the completion status (s3)+1, refer to the following.

 User's manual for the controller used

## Precautions

- If an error occurs in the mth protocol while multiple protocols are being executed, the instruction does not execute the "m+1"th protocol and after and is completed with an error.
- When a protocol including no-conversion variables is executed, the total data length of the variables used in one packet may exceed 1920 bytes. In this case, the instruction may obtain CPU device values over several scans. Therefore, do not change the CPU device values specified in non-conversion variables from the start of the instruction to the end of execution.
- Protocol cancellation
  - This instruction is completed with an error and stores the protocol cancel request error (C404H) in the device (completion status) specified by (s3)+1.
  - If a cancel request is issued while no protocol is being executed, the controller completes the cancel request without performing any processing.
  - While no communication protocol is used, any cancel request is ignored if issued.
  - When multiple protocols are executed continuously, a cancel request may be issued during execution of the nth protocol. In this case, the controller forcibly terminates the nth protocol and does not execute the subsequent protocols. Protocol number n being executed is stored in the device specified by ((s3)+0), the receive packet number successful in comparison match is stored in the device specified by 1 to (n-1), and the protocol cancel request error (C404H) is stored in the device specified by ((s3)+1).
  - The controller periodically checks for a cancel request. For this reason, it may take time until cancel processing is performed after a cancel request is issued.
- This instruction itself does not open/close a connection and therefore the SOCOPEN instruction/SOCCLOSE instructions need to be used to open/close the connection.

 Page 1146 GP.SOCOPEN, SP.SOCOPEN

 Page 1150 GP.SOCCLOSE, SP.SOCCLOSE

- If same instructions are executed for the same connection, the subsequent instruction is ignored and is not executed until the preceding instruction is completed.
- If the receive waiting time is set to "0: Infinite wait", this instruction is not completed until the data specified in the protocol setting is received.
- When "Send Only" is selected for the communication type, and data is sent to the external device by using TCP/IP protocol, the execution of this instruction is completed without checking the arrival of that data at the external device, and the completion status ((S3)+1) becomes completed successfully. Select "Send & Receive" for the communication type to check for the arrival of the sent data at the external device, so that a response from the external device is awaited before the instruction is completed.

# 29.4 SLMP Frame Send Instruction

## Sending an SLMP frame

### G(P).SLMPSND, J(P).SLMPSND, SP.SLMPSND

This instruction sends SLMP messages to the SLMP-compatible device.

- Point**
- The G(P).SLMPSND instruction can be used with the Ethernet port, CC-Link IE TSN port, and extension modules.
  - The J(P).SLMPSND instruction can be used with the CC-Link IE TSN port and extension modules.
  - The SP.SLMPSND instruction can be used only for the port for Ethernet.

| Ladder | ST                                                                                                                                                                                                                |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        | ENO:=G_SLMPSND( EN, U, s1, s2, d1, d2)<br>ENO:=GP_SLMPSND( EN, U, s1, s2, d1, d2)<br>ENO:=J_SLMPSND( EN, U, s1, s2, d1, d2)<br>ENO:=JP_SLMPSND( EN, U, s1, s2, d1, d2)<br>ENO:=SP_SLMPSND( EN, U, s1, s2, d1, d2) |

| FBD/LD |
|--------|
|        |

### ■Execution condition

| Instruction                            | Execution condition |
|----------------------------------------|---------------------|
| G.SLMPSND<br>J.SLMPSND                 |                     |
| GP.SLMPSND<br>JP.SLMPSND<br>SP.SLMPSND |                     |

## ■Description, range, data type

| Operand |              | Description                                                                                                                                 | Range                                           | Data type              | Data type (label)                                     |
|---------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|------------------------|-------------------------------------------------------|
| (U)     | G(P).SLMPSND | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number)                                                        | Ethernet port: 3E0H<br>CC-Link IE TSN port: 40H | 16-bit unsigned binary | ANY16                                                 |
|         | J(P).SLMPSND | Own station network number                                                                                                                  | 1 to 239                                        | 16-bit unsigned binary | ANY16                                                 |
|         | SP.SLMPSND   | Dummy                                                                                                                                       | —                                               | String                 | ANYSTRING_SINGLE                                      |
| (s1)    | G(P).SLMPSND | Start device where control data is stored                                                                                                   | ☞ Page 1186 Control data                        | Device                 | ANY16 <sup>*1</sup>                                   |
|         | J(P).SLMPSND |                                                                                                                                             |                                                 | Word                   |                                                       |
|         | SP.SLMPSND   |                                                                                                                                             |                                                 |                        |                                                       |
| (s2)    |              | Start device where a request frame is stored                                                                                                | ☞ Page 1187 Request frame                       | Word                   | ANY16 <sup>*1</sup>                                   |
| (d1)    |              | Start device for storing a response frame                                                                                                   | ☞ Page 1188 Response frame                      | Word                   | ANY16_ARRAY <sup>*2</sup>                             |
| (d2)    |              | Device that turns on for one scan upon completion of the instruction<br>When the instruction completes with an error, (d2)+1 also turns on. | —                                               | Bit                    | ANYBIT_ARRAY <sup>*2</sup><br>(Number of elements: 2) |
| EN      |              | Execution condition                                                                                                                         | —                                               | Bit                    | BOOL                                                  |
| ENO     |              | Execution result                                                                                                                            | —                                               | Bit                    | BOOL                                                  |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

\*2 When specifying setting data by using a label, define an array to secure enough operation area.

## ■Applicable devices

| Operand |              | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others |   |
|---------|--------------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|--------|---|
|         |              | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□□□□, J□□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ | U      | J |
| (U)     | G(P).SLMPSND | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | ○      | — |
|         | SP.SLMPSND   | —                                | —    | —                                     | —           | — | —           | —  | —                      | —        | — | —  | —      | ○ |
| (s1)    | J(P).SLMPSND | —                                | —    | —                                     | —           | — | —           | —  | —                      | —        | — | —  | —      | — |
| (s2)    |              | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      | — |
| (d1)    |              | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —      | — |
| (d2)    |              | ○                                | —    | ○ <sup>*1</sup>                       | —           | — | —           | —  | ○                      | —        | — | —  | —      | — |

\*1 T, ST, C, and FD cannot be used.

## ■Control data

| Operand: (s1) |                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                         |                 |
|---------------|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-----------------|
| Device        | Item                                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Setting range                                                                           | Set by          |
| +0            | Execution/error completion type                         | <div> <div> <div>b15</div> <div>b7</div> <div>b0</div> </div> <div> <div>(3)</div> <div>0</div> <div>(2)</div> <div>0</div> <div>(1)</div> </div> </div> <p>(1) Execution type (b0)</p> <ul style="list-style-type: none"> <li>• 0: Without arrival check (The instruction is regarded as completed when a request message is sent from own station.)<sup>*1</sup></li> <li>• 1: With arrival check (The instruction is regarded as completed when a response message is received from the external device.)</li> </ul> <p>(2) Error completion type (b7)</p> <p>Specify whether to set data at completion with an error.</p> <ul style="list-style-type: none"> <li>• 0: Do not set data at completion with an error in (s1)+13 and later. (Clear (s1)+13 and later.)</li> <li>• 1: Set data at completion with an error in (s1)+13 and later.</li> </ul> <p>(3) Instruction type (b15)</p> <ul style="list-style-type: none"> <li>• 0: Operand (U) is specified as 00H to FEH</li> <li>• 1: Operand (U) is specified as 3E0H</li> </ul> | —                                                                                       | User            |
| +1            | Completion status                                       | <p>The completion status is stored upon completion of the instruction.</p> <p>0000H: Completed successfully</p> <p>Other than 0000H: Completed with an error (error code)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | —                                                                                       | System          |
| +2            | Own station channel                                     | <p>Specify the channel to be used by own station. Since whether or not a serial number<sup>*4</sup> is given to the request message depends on the channel, specify the channel as follows according to the application.</p> <p>When using in conjunction with the SLMPSEND instruction, be careful not to overlap the channels because the channel where serial numbers are given is shared.</p> <ul style="list-style-type: none"> <li>• 1: No serial number is given</li> <li>• 2 to 9: Serial number is given</li> <li>• 10 to 17: Station number extension frame</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                          | • 1 to 17 <sup>*2</sup>                                                                 | User            |
| +3            | IP address of external device (third and fourth octets) | <p>Specify the IP address (third and fourth octets) of external device.</p> <div> <div>b15</div> <div>b8 b7</div> <div>b0</div> </div> <div> <div>3</div> <div>4</div> </div> <p>3, 4: Indicates the octets of the IP address.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 00000001H~FFF<br>FFFFEH (both<br>(s1)+3 and<br>(s1)+4 together)<br>(1 to<br>4294967294) | User            |
| +4            | IP address of external device (first and second octets) | <p>Specify the IP address (first and second octets) of external device.</p> <div> <div>b15</div> <div>b8 b7</div> <div>b0</div> </div> <div> <div>1</div> <div>2</div> </div> <p>1, 2: Indicates the octets of the IP address.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                         | User            |
| +5            | Destination port number                                 | Specify the destination port number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1 to 65534<br>(1 to FFFEH)                                                              | User            |
| +6            | Request destination network number                      | 0000H (fixed)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0000H                                                                                   | User            |
| +7            | Request destination station number                      | 00FFH (fixed)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 00FFH                                                                                   | User            |
| +8            | Request destination module I/O number                   | <p>Specify a module I/O number of the request destination.</p> <ul style="list-style-type: none"> <li>• 03FFH: Own station/control CPU</li> <li>• 03E0H: Multiple CPU No.1</li> <li>• 03E1H: Multiple CPU No.2</li> <li>• 03E2H: Multiple CPU No.3</li> <li>• 03E3H: Multiple CPU No.4</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 03FFH, 03E0H<br>to 03E3H                                                                | User            |
| +9            | Request destination multidrop station number            | Specify a multidrop number of the external device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0000H to<br>FFFEH <sup>*3</sup>                                                         | User            |
| +10           | Number of resends                                       | <p>The device becomes effective when the execution type specified by (s1)+0 is "1: With arrival check".</p> <p>■Before instruction execution</p> <p>Specify the number of resends to be performed if the instruction is not completed within the monitoring time specified by (s1)+11.</p> <ul style="list-style-type: none"> <li>• 0 to 15 (times)</li> </ul> <p>■At completion of instruction</p> <p>The number of resends performed (result) is stored.</p> <ul style="list-style-type: none"> <li>• 0 to 15 (times)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0 to 15                                                                                 | User/<br>system |

| Operand: (s1) |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |        |
|---------------|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item                                                          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Setting range | Set by |
| +11           | Arrival monitoring time                                       | Specify the monitoring time until completion of processing. If processing is not completed within the monitoring time, the request is resent the number of times specified in (s1)+10.<br>• 0: 10s<br>• 1 to 32767: 1 to 32767s                                                                                                                                                                                                                                                                                                                                                                                                  | 0 to 32767    | User   |
| +12           | Clock setting flag                                            | The validity status (valid or invalid) of the data in (s)+13 and later is stored. Note that the data in (s1)+13 and later is cleared when the instruction is completed successfully.<br>• 0: Invalid<br>• 1: Valid                                                                                                                                                                                                                                                                                                                                                                                                               | —             | System |
| +13           | Clock data                                                    | Upper 8 bits: Month (01H to 12H)<br>Lower 8 bits: Year (00H to 99H: Lower two digits of the year)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | —             | System |
| +14           |                                                               | Upper 8 bits: Hour (00H to 23H)<br>Lower 8 bits: Day (01H to 31H)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |        |
| +15           |                                                               | Upper 8 bits: Second (00H to 59H)<br>Lower 8 bits: Minute (00H to 59H)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |        |
| +16           |                                                               | Upper 8 bits: Year (00H to 99H: Upper two digits of the year)<br>Lower 8 bits: Day of the week (00H (Sun.) to 06H (Sat.))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |        |
| +17           | IP address of error detected device (third and fourth octets) | The IP address (third and fourth octets) of the station where an error was detected is stored.<br><br><div style="display: flex; justify-content: space-around; align-items: center;"> <span>b15</span> <span>b8 b7</span> <span>b0</span> </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; width: 100px; height: 20px; text-align: center; line-height: 20px;">3</div> <div style="border: 1px solid black; width: 100px; height: 20px; text-align: center; line-height: 20px;">4</div> </div> <p>3, 4: Indicates the octets of the IP address.</p> | —             | System |
| +18           | IP address of error detected device (first and second octets) | The IP address (first and second octets) of the station where an error was detected is stored.<br><br><div style="display: flex; justify-content: space-around; align-items: center;"> <span>b15</span> <span>b8 b7</span> <span>b0</span> </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; width: 100px; height: 20px; text-align: center; line-height: 20px;">1</div> <div style="border: 1px solid black; width: 100px; height: 20px; text-align: center; line-height: 20px;">2</div> </div> <p>1, 2: Indicates the octets of the IP address.</p> | —             | System |

\*1 If (s1)+0 is set to "0: Without arrival check", receive data is not set. Set 0 in (s1)+0 in the following cases:

- When a command that does not return a response message is used
- When a response message is not referred to

\*2 If operand (U) is specified as 3E0H, 1 to 9 can be specified.

\*3 If operand (U) is specified as 3E0H, it is fixed to 0000H.

\*4 Give the serial numbers when sending several request messages to the same SLMP-compatible device. Serial numbers to be given are automatically numbered by the system.

For the serial number, refer to the following.

 SLMP Reference Manual

## Request frame

| Operand: (s2) |                     |                                                                                                                                                                                                                                                                         |               |        |
|---------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item                | Description                                                                                                                                                                                                                                                             | Setting range | Set by |
| +0            | Request data length | Specify the data length from the monitoring timer to the request data. (In units of bytes)                                                                                                                                                                              | 1 to 2000     | User   |
| +1            | Monitoring timer    | This timer sets the waiting time for the external device that received a request message to wait for the response after it issued a processing request to the access destination. (Unit: Increments of 250ms)<br>• 0: Infinite wait<br>• 1 to 65535: 1 to 65535 × 250ms | 0 to 65535    | User   |
| +2 to +□      | Request data        | The request data of the SLMP message is stored.                                                                                                                                                                                                                         | —             | User   |

## ■Response frame

| Operand: (d1) |                             |                                                                                                                                                                                                                     |               |        |
|---------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item                        | Description                                                                                                                                                                                                         | Setting range | Set by |
| +0            | Response data length        | The data length from the end code to the response data is stored. (In units of bytes)                                                                                                                               | 2 to 2000     | System |
| +1            | End code                    | The result of command processing is stored.<br>In normal end, 0 is stored. In abnormal end, an error code set by the external device is stored.                                                                     | —             | System |
| +2 to +□      | Response data <sup>*1</sup> | Sets execution results for the request data.<br>For details on the request data, refer to the following.<br> SLMP Reference Manual | —             | System |

<sup>\*1</sup> The response data is stored in units of bytes sequentially from lower bytes. When an odd number of bytes of response data is received, the last response data is stored in the lower byte of the last data storage area.

## Processing details

- This instruction sends the request frame in the device specified by (s2) and later to the external device specified by the external device IP address in the control data. When a response message is received from the external device, it is stored in the device specified by (d1).
- This instruction uses UDP communications. Set the external device to use UDP.
- This instruction communicates in binary code. Match the setting of the external device also with the binary code.
- The execution status and the completion status of this instruction can be checked with the completion device (d2)+0 specified by the setup data and the completion status indication device (d2)+1.
- Completion device (d2)+0

This device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

- Completion status indication device (d2)+1

This device turns on or off depending on the completion status of this instruction.

Completed successfully: The device remains off.

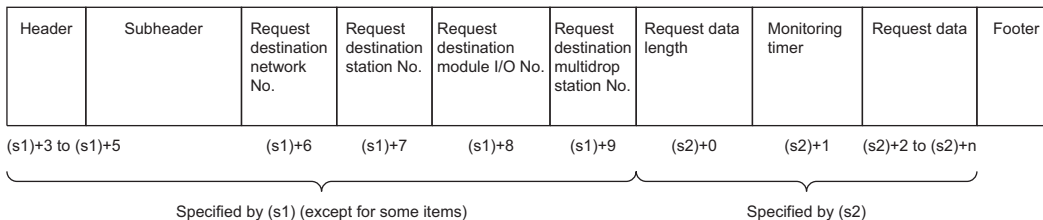
Completed with an error: The device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

- When an odd number of bytes of response data is received, invalid data is stored in the upper byte of the device where the last response data is stored.

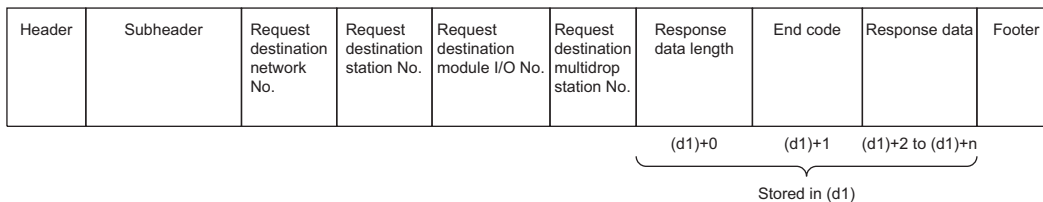
### ■Message format (3E/4E frame)

The following figures show the request data of 3E/4E frame and the response data in normal/abnormal end.

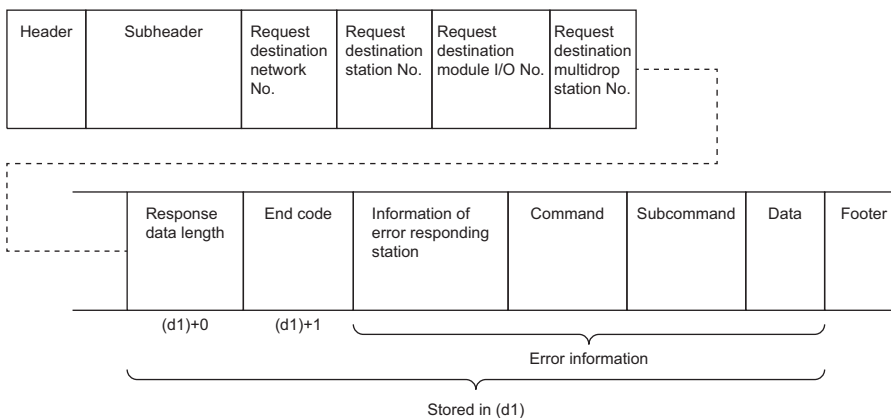
- Request message



- Response message (in normal end)



- Response message (in abnormal end)

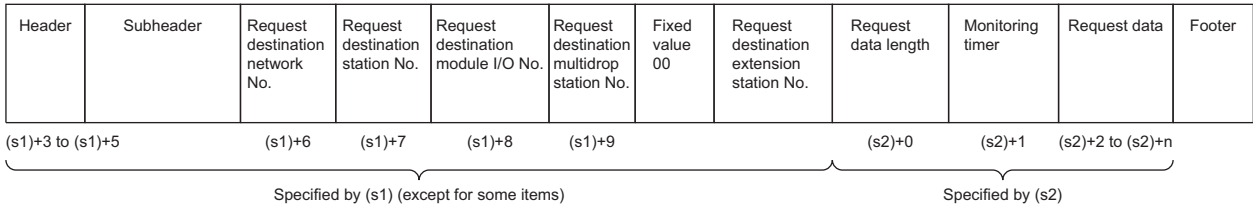


The network number, station number, request destination module I/O number, and multidrop station number are stored to the information of the error responding station.

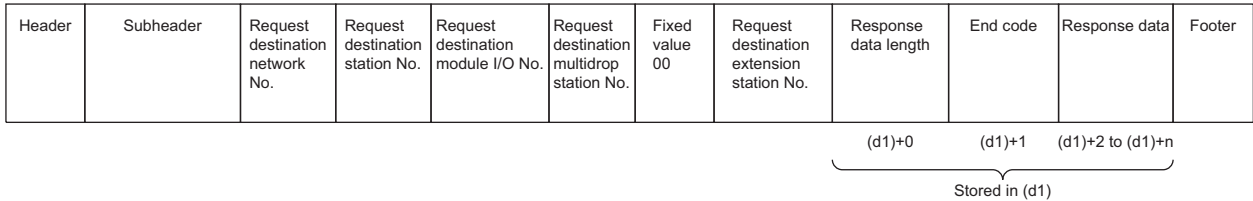
■Message format (station number extension frame)

The following figures show the request data of station number extension frame and the response data in normal/abnormal end.

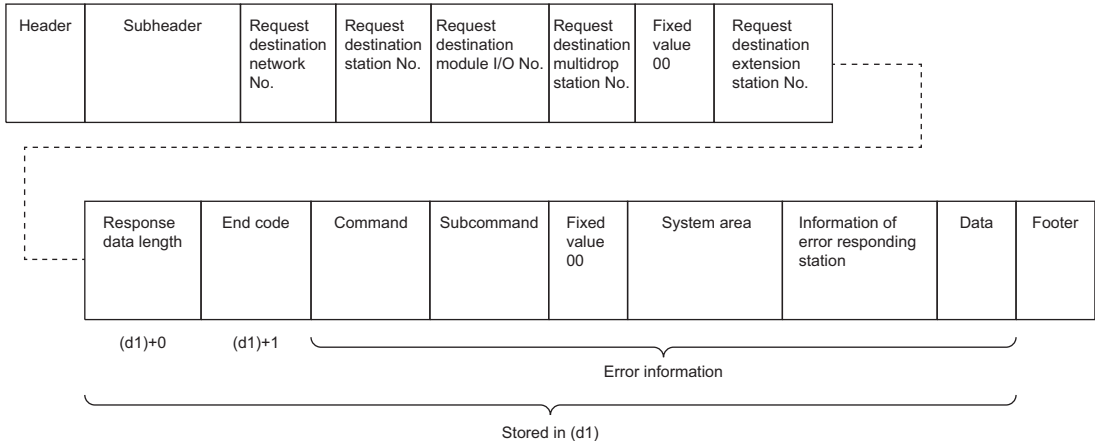
• Request message



• Response message (in normal end)



• Response message (in abnormal end)



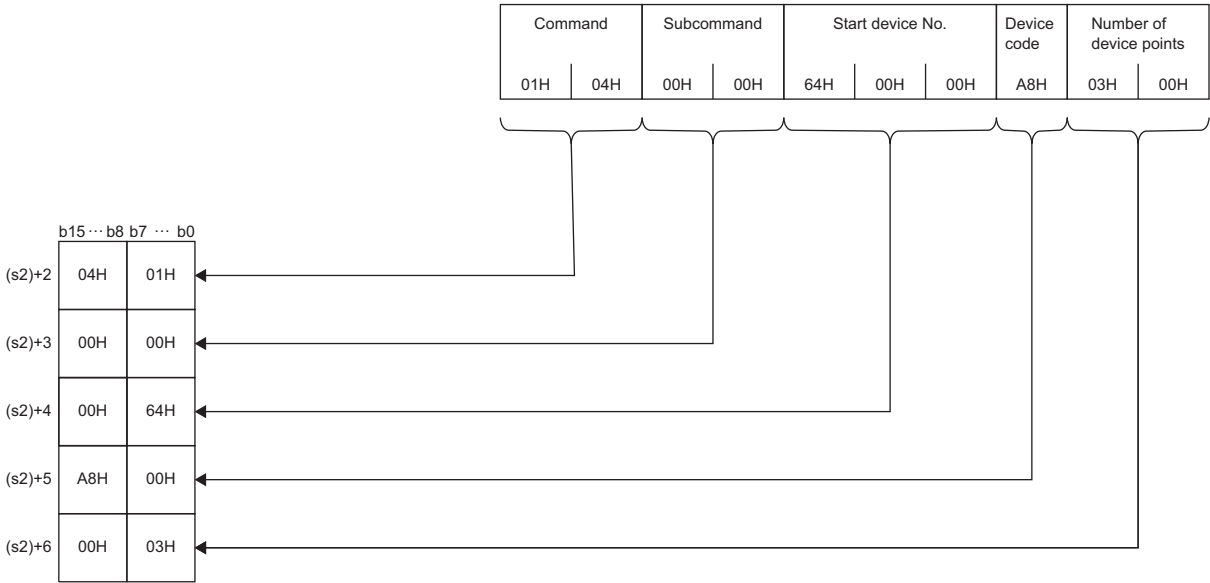
The network number, station number, request destination module I/O number, multidrop station number, 00 (fixed value), and extension station number are stored to the information of the error responding station.



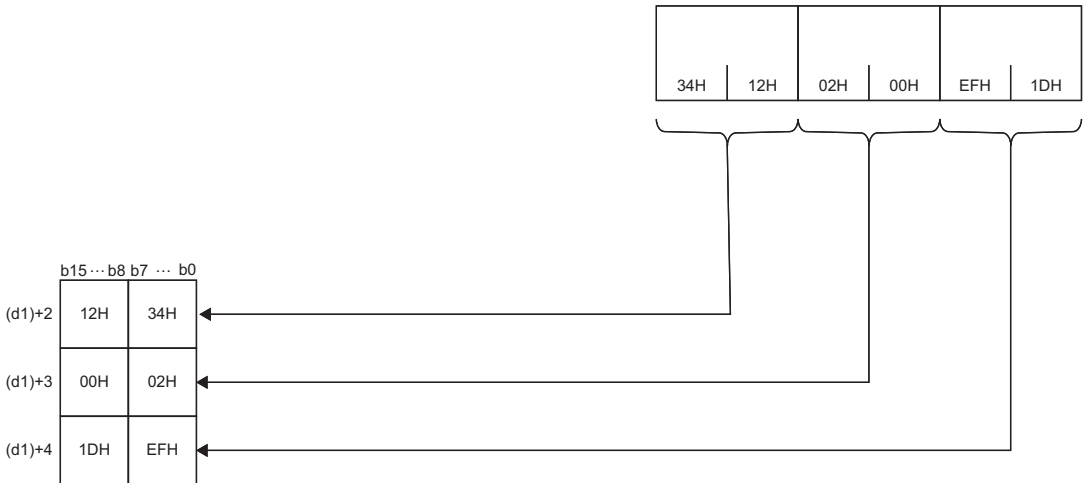
**Ex.**

When sending "Read (command: 0401H)" (reading in units of words) which reads the value in D100 to D102

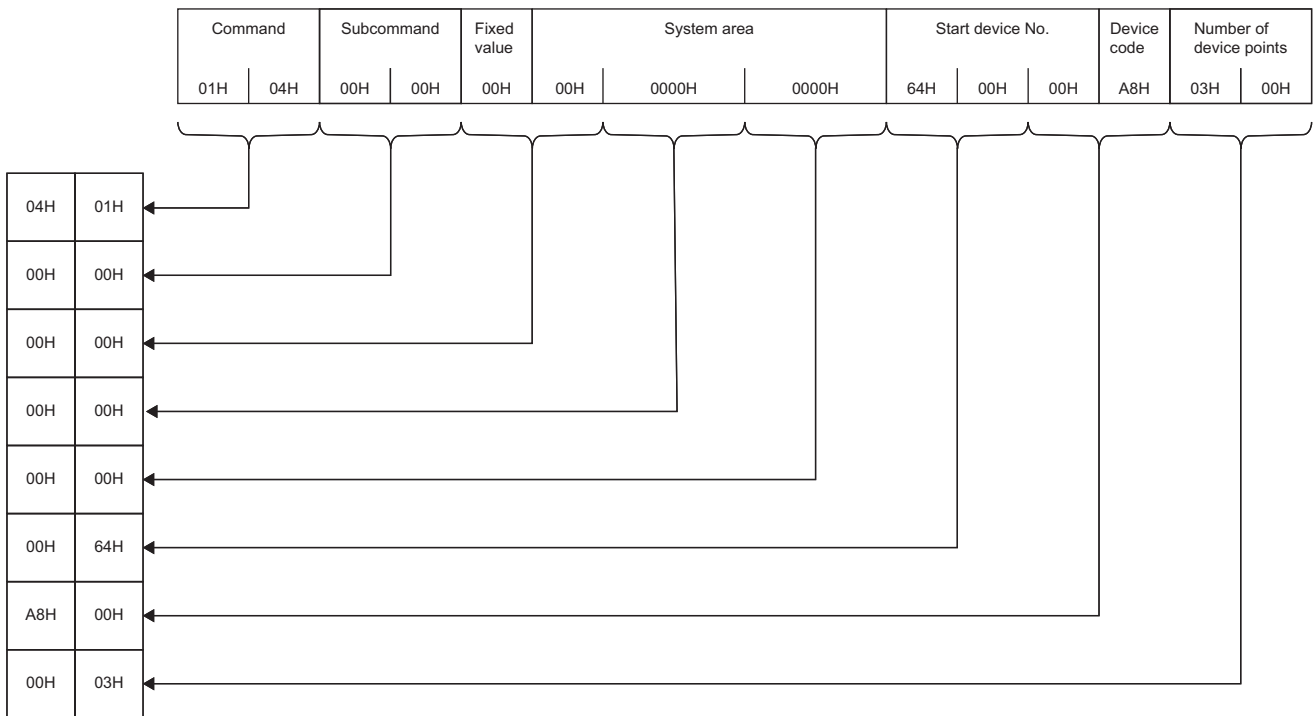
- The following example shows that request data is stored in (s2)+2 and later (3E/4E frame).



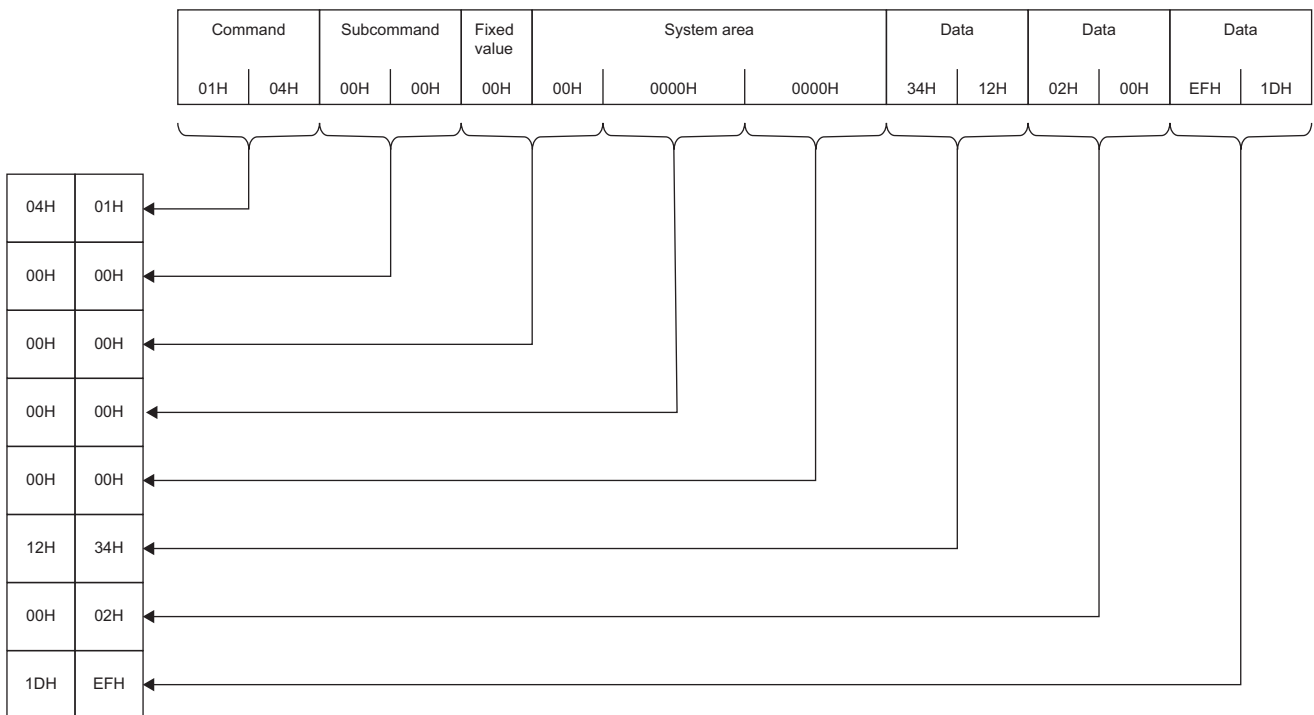
- The following example shows that response data is stored in (d1)+2 and later (3E/4E frame).



- The following example shows that request data is stored in (s2)+2 and later (station number extension frame).

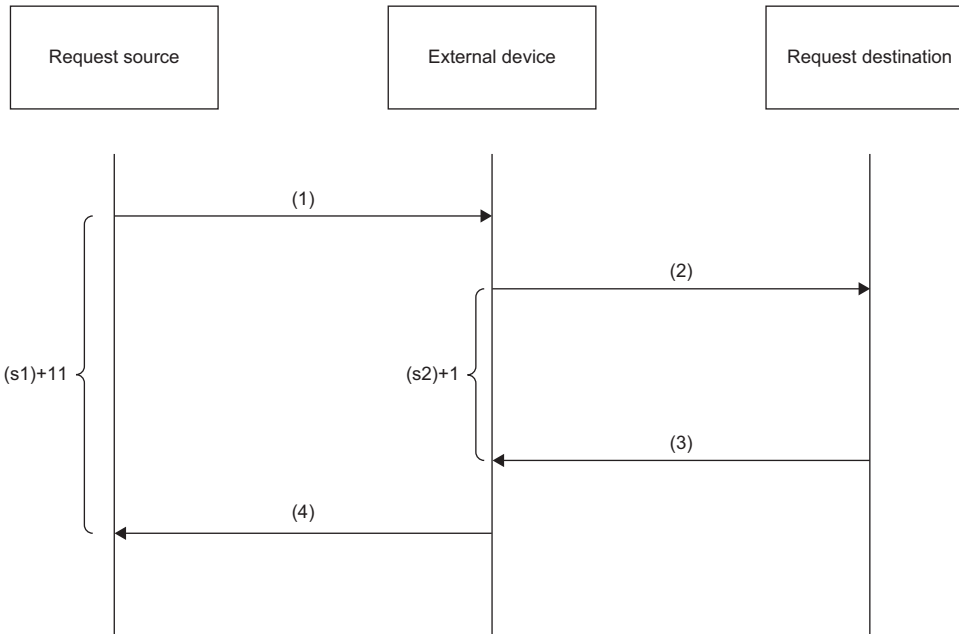


- The following example shows that response data is stored in (d1)+2 and later (station number extension frame).



## Precautions

- During the execution of the SLMPSEND instruction, if another SLMPSEND instruction specifying the same channel is executed, the later instruction is ignored. At this time, as long as the execution conditions of the instruction are met, the request is executed after the first instruction being executed completes. SM699 (Dedicated instruction skip flag) turns on while the request is ignored.
- Specify the arrival monitoring time ((s1)+11) of the control data and monitoring timer ((s2)+1) of the request frame so that the arrival monitoring time  $\geq$  monitoring timer.



- (1) Request message  
 (2) Processing request from external device to request destination  
 (3) Processing response from request destination to external device  
 (4) Response message

### Point

This instruction is successfully completed even if the target device returns an abnormal response. When this instruction is completed successfully, the response is whether normal or abnormal can be identified by the end code of the response frame. When an abnormal response is returned, check the manual of the SLMP-compatible device being used and take corrective action.

## Operation error

| Error code (SD0) | Description                                                                             |
|------------------|-----------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port. |
| 3285H            | The value set to (s1)+2 as own station channel is out of the range.                     |
|                  | The value set to (s2)+0 as the request data length is 0 or exceeds 2000.                |

Upon completion with an error, the completion status indication device (d2)+1 is turned on and an error code is stored in the completion status (s1)+1. For the error code stored in the completion status (s1)+1, refer to the following.

User's manual for the controller used

# Sending an encrypted SLMP frame

## G(P).SLMPSNDC

Sends encrypted SLMP messages to the SLMP-compatible device.



This instruction can be used with the Ethernet port and extension modules.

| Ladder | ST                                                                                  |
|--------|-------------------------------------------------------------------------------------|
|        | ENO:=G_SLMPSNDC( EN, U, s1, s2, d1, d2)<br>ENO:=GP_SLMPSNDC( EN, U, s1, s2, d1, d2) |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction | Execution condition |
|-------------|---------------------|
| G.SLMPSNDC  |                     |
| GP.SLMPSNDC |                     |

## Setting data

### Description, range, data type

| Operand | Description                                                                                                                                 | Range                    | Data type              | Data type (label)                                     |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------|-------------------------------------------------------|
| (U)     | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number)                                                        | 3E0H                     | 16-bit unsigned binary | ANY16                                                 |
| (s1)    | Start device where control data is stored                                                                                                   | Page 1186 Control data   | Device name            | ANY16 <sup>*1</sup>                                   |
| (s2)    | Start device where a request frame is stored                                                                                                | Page 1187 Request frame  | Device name            | ANY16 <sup>*1</sup>                                   |
| (d1)    | Start device for storing a response frame                                                                                                   | Page 1188 Response frame | Device name            | ANY16_ARRAY <sup>*2</sup>                             |
| (d2)    | Device that turns on for one scan upon completion of the instruction<br>When the instruction completes with an error, (d2)+1 also turns on. | —                        | Bit                    | ANYBIT_ARRAY <sup>*2</sup><br>(Number of elements: 2) |
| EN      | Execution condition                                                                                                                         | —                        | Bit                    | BOOL                                                  |
| ENO     | Execution result                                                                                                                            | —                        | Bit                    | BOOL                                                  |

\*1 When specifying setting data by using a label, define an array to secure enough operation area and specify an element of the array label.

\*2 When specifying setting data by using a label, define an array to secure enough operation area.

### ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | ○          |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |
| (d1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |
| (d2)    | ○                                | —   | ○ <sup>*1</sup>                       | —          | — | —           | —  | ○                      | —        | — | —  | —          |

\*1 T, ST, C, and FD cannot be used.

## ■Control data

| Operand: (s1) |                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                         |        |
|---------------|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------|
| Device        | Item                                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Setting range                                                           | Set by |
| +0            | Execution/error completion type                         | <div> <div> <div>b15</div> <div>b7</div> <div>b0</div> </div> <div> <div>(3)</div> <div>0</div> <div>(2)</div> <div>0</div> <div>(1)</div> </div> </div> <p>(1) Execution type (b0)</p> <ul style="list-style-type: none"> <li>• 0: Without arrival check (The instruction is regarded as completed when a request message is sent from own station.)<sup>*1</sup></li> <li>• 1: With arrival check (The instruction is regarded as completed when a response message is received from the external device.)</li> </ul> <p>(2) Error completion type (b7)</p> <p>Specify whether to set data at completion with an error.</p> <ul style="list-style-type: none"> <li>• 0: Do not set data at completion with an error in (s1)+13 and later. (Clear (s1)+13 and later.)</li> <li>• 1: Set data at completion with an error in (s1)+13 and later.</li> </ul> | —                                                                       | User   |
| +1            | Completion status                                       | <p>The completion status is stored upon completion of the instruction.</p> <p>0: Completed successfully</p> <p>Other than 0: Completed with an error (error code)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | —                                                                       | System |
| +2            | Own station channel                                     | <p>Specify the channel to be used by own station. Since whether or not a serial number<sup>*2</sup> is given to the request message depends on the channel, specify the channel as follows according to the application.</p> <ul style="list-style-type: none"> <li>• 1: No serial number is given</li> <li>• 2 to 9: Serial number is given</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1 to 9                                                                  | User   |
| +3            | Own station port number.                                | <p>Specify the port number of the own station. When setting a channel where a serial number is given, be careful to specify the own station port number so that it does not overlap.</p> <p>When using in conjunction with the SLMPSEND instruction, be careful not to overlap the channels because the channel where serial numbers are given is shared.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1 to 4999, 5010 to 65534<br>(1H to 1387H, 1392H to FFEH)                | User   |
| +4            | IP address of external device (third and fourth octets) | <p>Specify the IP address (third and fourth octets) of external device.</p> <div> <div>b15</div> <div>b8 b7</div> <div>b0</div> </div> <div> <div>3</div> <div>4</div> </div> <p>3, 4: Indicates the octets of the IP address.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 00000001H~FFF FFFFH (both (s1)+3 and (s1)+4 together) (1 to 4294967294) | User   |
| +5            | IP address of external device (first and second octets) | <p>Specify the IP address (first and second octets) of external device.</p> <div> <div>b15</div> <div>b8 b7</div> <div>b0</div> </div> <div> <div>1</div> <div>2</div> </div> <p>1, 2: Indicates the octets of the IP address.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                         | User   |
| +6            | Destination port number                                 | Specify the destination port number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1 to 65534<br>(1 to FFEH)                                               | User   |
| +7            | Request destination network number                      | 0000H (fixed)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0000H                                                                   | User   |
| +8            | Request destination station number                      | 00FFH (fixed)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 00FFH                                                                   | User   |

| Operand: (s1) |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                       |             |
|---------------|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------|
| Device        | Item                                                          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Setting range         | Set by      |
| +9            | Request destination module I/O number                         | Specify a module I/O number of the request destination.<br><ul style="list-style-type: none"> <li>• 03FFH: Own station/control CPU</li> <li>• 03E0H: Multiple CPU No.1</li> <li>• 03E1H: Multiple CPU No.2</li> <li>• 03E2H: Multiple CPU No.3</li> <li>• 03E3H: Multiple CPU No.4</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                | 03FFH, 03E0H to 03E3H | User        |
| +10           | Request destination multidrop station number                  | 0000H (fixed)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0000H                 | User        |
| +11           | Number of resends                                             | The device becomes effective when the execution type specified by (s1)+0 is "1: With arrival check".<br><b>■ Before instruction execution</b><br>Specify the number of resends to be performed if the instruction is not completed within the monitoring time specified by (s1)+11.<br><ul style="list-style-type: none"> <li>• 0 to 15 (times)</li> </ul> <b>■ At completion of instruction</b><br>The number of resends performed (result) is stored.<br><ul style="list-style-type: none"> <li>• 0 to 15 (times)</li> </ul>                                                                                                                                                                               | 0 to 15               | User/system |
| +12           | Arrival monitoring time                                       | Specify the monitoring time until completion of processing. If processing is not completed within the monitoring time, the request is resent the number of times specified in (s1)+10.<br><ul style="list-style-type: none"> <li>• 0: 10s</li> <li>• 1 to 32767: 1 to 32767s</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                      | 0 to 32767            | User        |
| +13           | Clock setting flag                                            | The validity status (valid or invalid) of the data in (s)+13 and later is stored. Note that the data in (s1)+13 and later is cleared when the instruction is completed successfully.<br><ul style="list-style-type: none"> <li>• 0: Invalid</li> <li>• 1: Valid</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                   | —                     | System      |
| +14           | Clock data                                                    | Upper 8 bits: Month (01H to 12H)<br>Lower 8 bits: Year (00H to 99H: Lower two digits of the year)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | —                     | System      |
| +15           |                                                               | Upper 8 bits: Hour (00H to 23H)<br>Lower 8 bits: Day (01H to 31H)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                       |             |
| +16           |                                                               | Upper 8 bits: Second (00H to 59H)<br>Lower 8 bits: Minute (00H to 59H)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                       |             |
| +17           |                                                               | Upper 8 bits: Year (00H to 99H: Upper two digits of the year)<br>Lower 8 bits: Day of the week (00H (Sun.) to 06H (Sat.))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                       |             |
| +18           | IP address of error detected device (third and fourth octets) | The IP address (third and fourth octets) of the station where an error was detected is stored.<br><br><div style="display: flex; justify-content: space-around; align-items: center;"> <span>b15</span> <span>b8 b7</span> <span>b0</span> </div> <div style="display: flex; justify-content: space-around; align-items: center; border: 1px solid black; padding: 2px;"> <div style="border: 1px solid black; width: 100px; height: 20px; display: flex; align-items: center; justify-content: center;">3</div> <div style="border: 1px solid black; width: 100px; height: 20px; display: flex; align-items: center; justify-content: center;">4</div> </div> 3, 4: Indicates the octets of the IP address. | —                     | System      |
| +19           | IP address of error detected device (first and second octets) | The IP address (first and second octets) of the station where an error was detected is stored.<br><br><div style="display: flex; justify-content: space-around; align-items: center;"> <span>b15</span> <span>b8 b7</span> <span>b0</span> </div> <div style="display: flex; justify-content: space-around; align-items: center; border: 1px solid black; padding: 2px;"> <div style="border: 1px solid black; width: 100px; height: 20px; display: flex; align-items: center; justify-content: center;">1</div> <div style="border: 1px solid black; width: 100px; height: 20px; display: flex; align-items: center; justify-content: center;">2</div> </div> 1, 2: Indicates the octets of the IP address. | —                     | System      |

\*1 If (s1)+0 is set to "0: Without arrival check", receive data is not set. Set 0 in (s1)+0 in the following cases:

- When a command that does not return a response message is used
- When a response message is not referred to

\*2 Give the serial numbers when sending several request messages to the same SLMP-compatible device. Serial numbers to be given are automatically numbered by the system.

For the serial number, refer to the following.

 SLMP Reference Manual

## ■Request frame

| Operand: (s2) |                     |                                                                                                                                                                                                                                                                         |               |        |
|---------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item                | Description                                                                                                                                                                                                                                                             | Setting range | Set by |
| +0            | Request data length | Specify the data length from the monitoring timer to the request data. (In units of bytes)                                                                                                                                                                              | 1 to 2000     | User   |
| +1            | Monitoring timer    | This timer sets the waiting time for the external device that received a request message to wait for the response after it issued a processing request to the access destination. (Unit: Increments of 250ms)<br>• 0: Infinite wait<br>• 1 to 65535: 1 to 65535 × 250ms | 0 to 65535    | User   |
| +2 to +□      | Request data        | The request data of the SLMP message is stored.                                                                                                                                                                                                                         | —             | User   |

## ■Response frame

| Operand: (d1) |                             |                                                                                                                                                 |               |        |
|---------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|
| Device        | Item                        | Description                                                                                                                                     | Setting range | Set by |
| +0            | Response data length        | The data length from the end code to the response data is stored. (In units of bytes)                                                           | 2 to 2000     | System |
| +1            | End code                    | The result of command processing is stored.<br>In normal end, 0 is stored. In abnormal end, an error code set by the external device is stored. | —             | System |
| +2 to +□      | Response data <sup>*1</sup> | Sets execution results for the request data.<br>(Some commands do not return response data.)                                                    | —             | System |

\*1 The response data is stored in units of bytes sequentially from lower bytes. When an odd number of bytes of response data is received, the last response data is stored in the lower byte of the last data storage area.

## Processing details

- This instruction sends the request frame in the device specified by (s2) and later to the external device specified by the external device IP address in the control data. When a response message is received from the external device, it is stored in the device specified by (d1).
- This instruction uses DTLS communications. Set the external device to use DTLS.
- This instruction communicates in binary code. Match the setting of the external device also with the binary code.
- The execution status and the completion status of this instruction can be checked with the completion device (d2)+0 specified by the setup data and the completion status indication device (d2)+1.
- Completion device (d2)+0

This device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

- Completion status indication device (d2)+1

This device turns on or off depending on the completion status of this instruction.

Completed successfully: The device remains off.

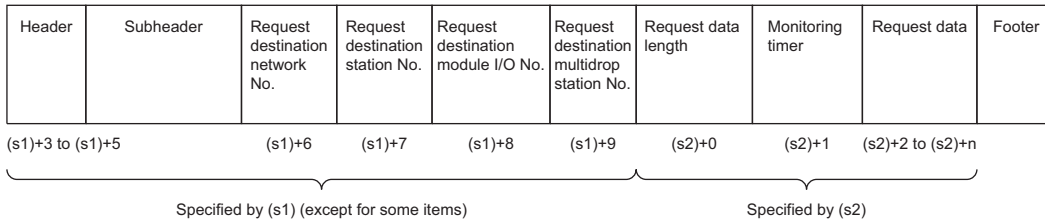
Completed with an error: The device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

- When an odd number of bytes of response data is received, invalid data is stored in the upper byte of the device where the last response data is stored.

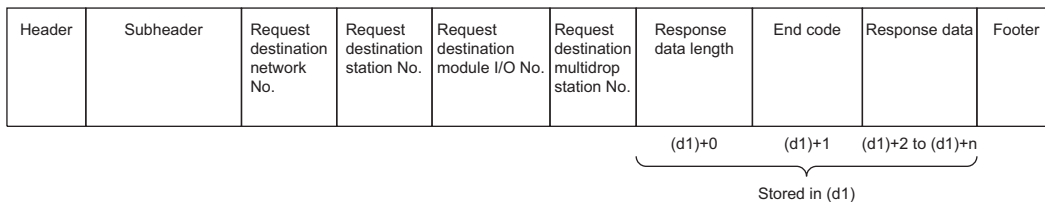
### ■Message format (3E/4E frame)

The following figures show the request data of 3E/4E frame and the response data in normal/abnormal end.

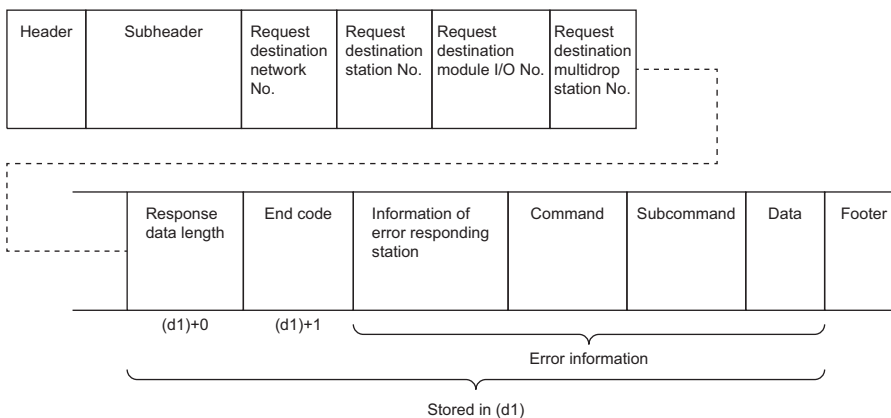
- Request message



- Response message (in normal end)



- Response message (in abnormal end)



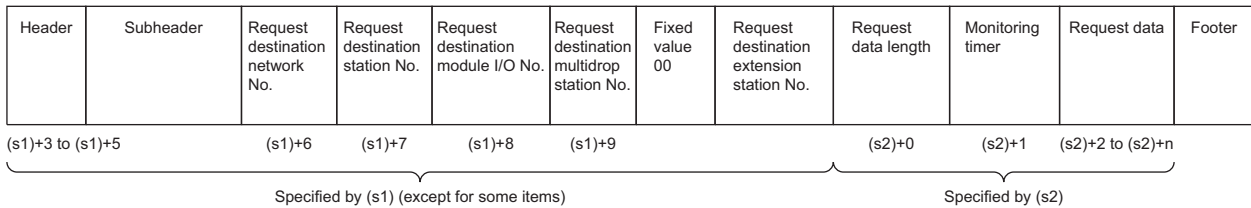
The network number, station number, request destination module I/O number, and multidrop station number are stored to the information of the error responding station.



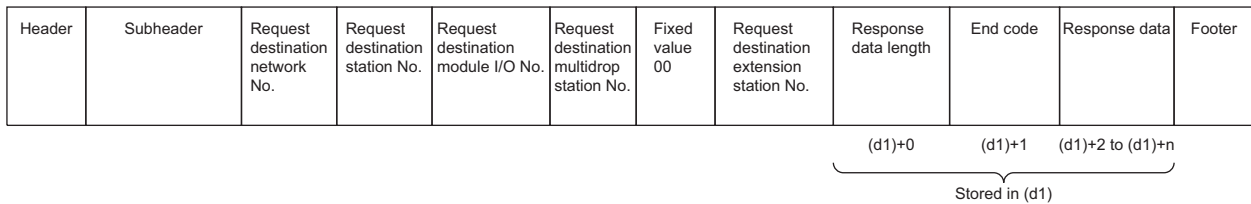
## ■ Message format (station number extension frame)

The following figures show the request data of station number extension frame and the response data in normal/abnormal end.

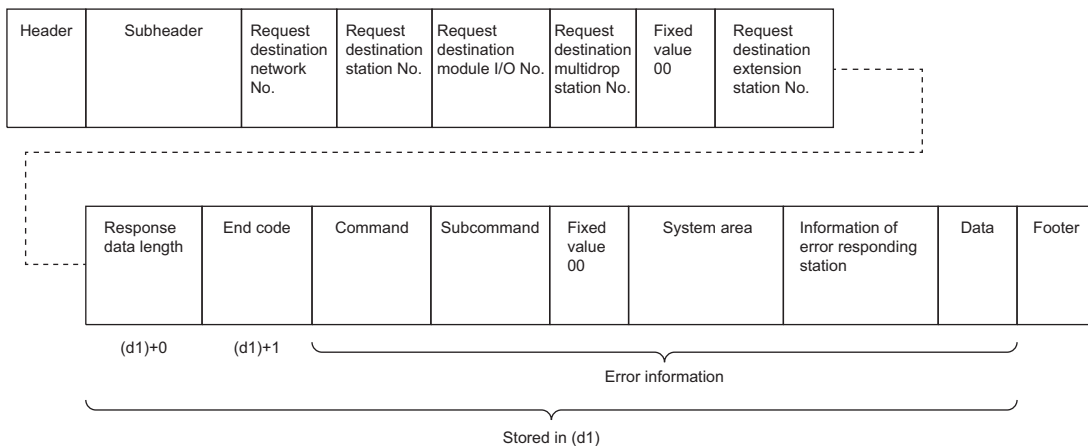
### • Request message



### • Response message (in normal end)



### • Response message (in abnormal end)

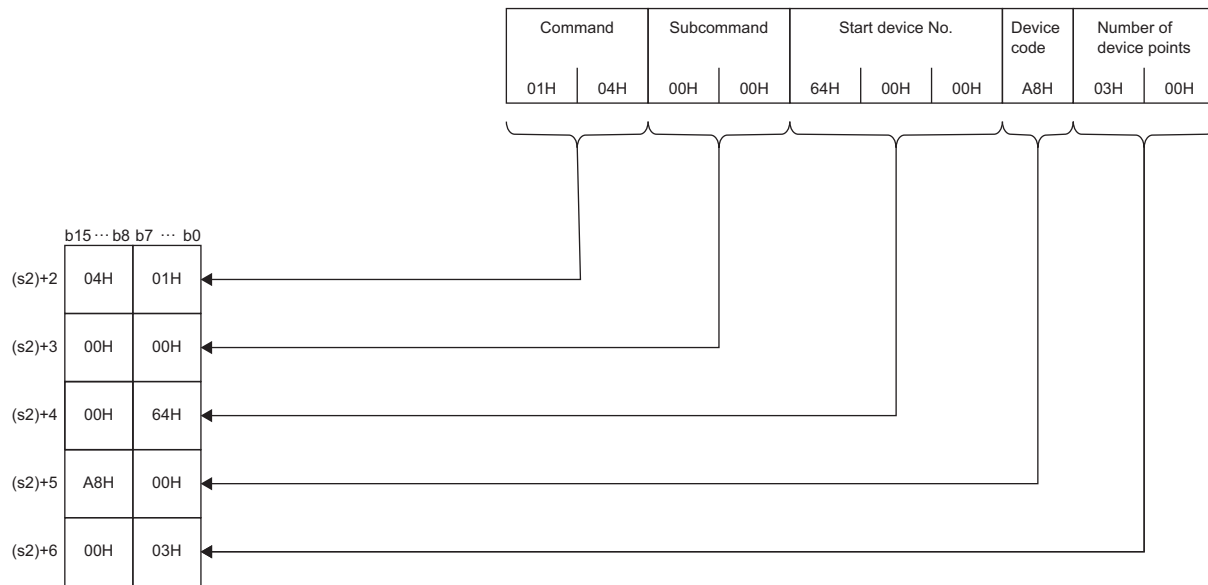


The network number, station number, request destination module I/O number, multidrop station number, 00 (fixed value), and extension station number are stored to the information of the error responding station.

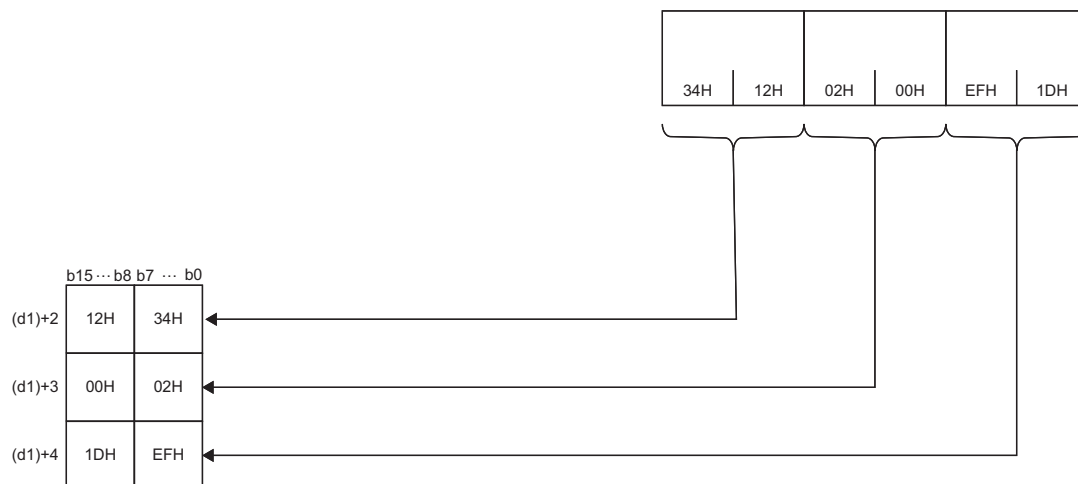
**Ex.**

When sending "Read (command: 0401H)" (reading in units of words) which reads the value in D100 to D102

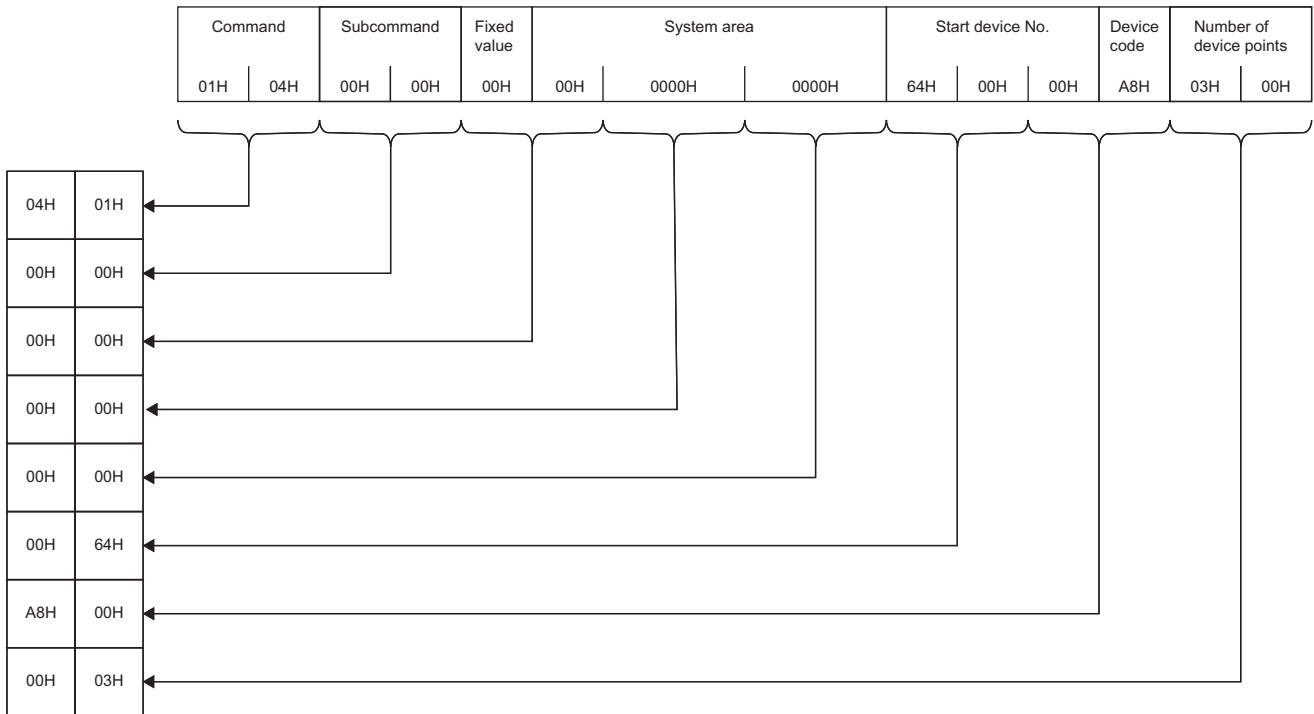
- The following example shows that request data is stored in (s2)+2 and later (3E/4E frame).



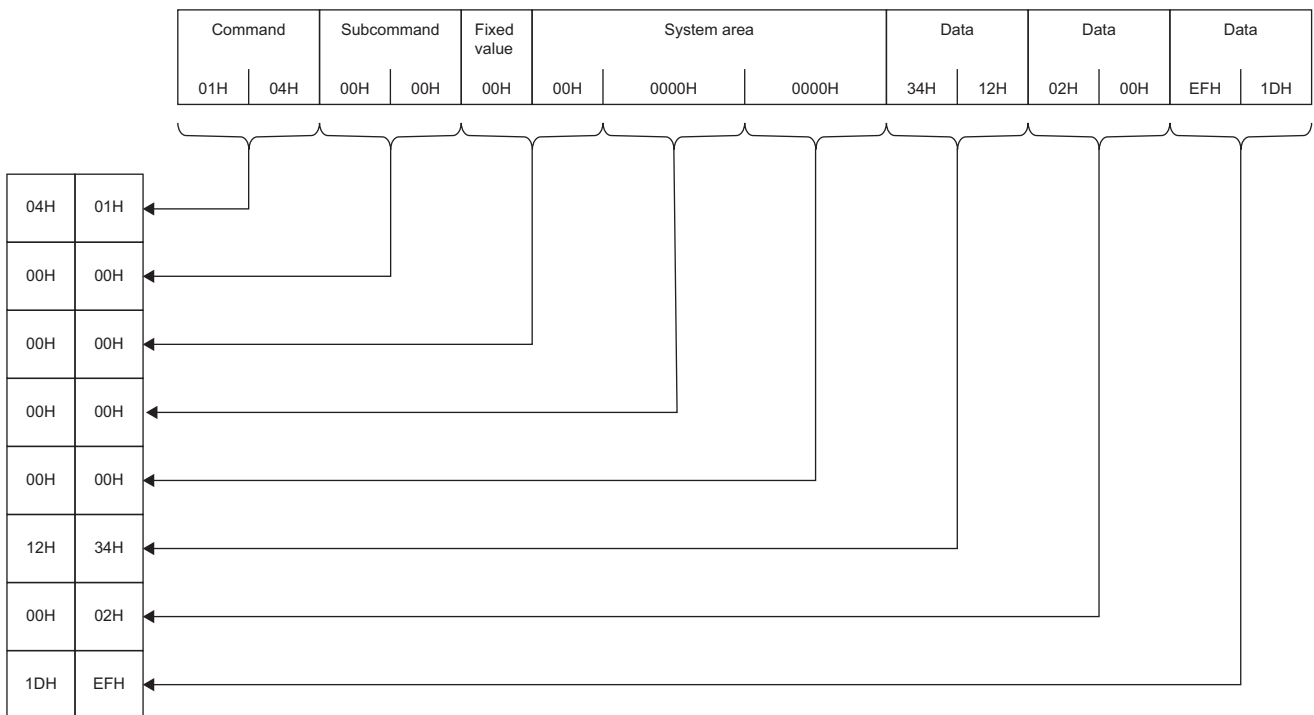
- The following example shows that response data is stored in (d1)+2 and later (3E/4E frame).



- The following example shows that request data is stored in (s2)+2 and later (station number extension frame).

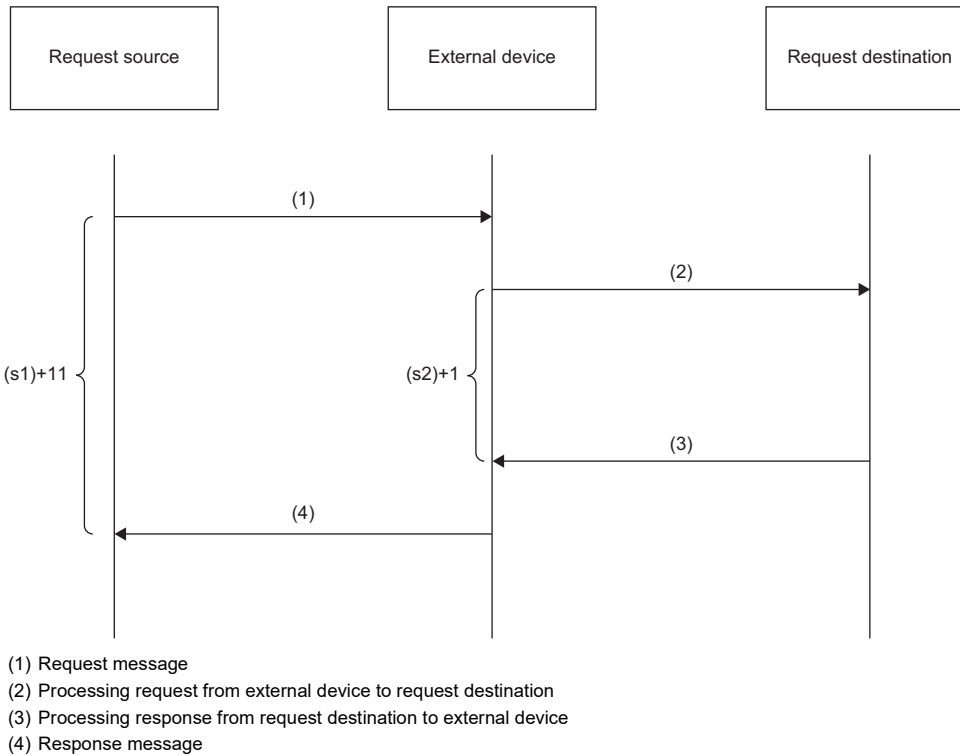


- The following example shows that response data is stored in (d1)+2 and later (station number extension frame).



## Precautions

- When executing some of this instructions concurrently, be careful to set the channels of this instruction not to overlap. This instruction specifying the same channels cannot be used concurrently. When the execution conditions of this instruction in the same channel are satisfied in the same sequence scan, only this instruction that has been executed first is enabled and the subsequent instructions are not executed. In addition, any subsequent instruction of the same channel setting as this instruction being executed is not executed. If the controller does not execute the processing of this instruction, SM699 (Dedicated instruction skip flag) turns on.
- Specify the arrival monitoring time  $((s1)+11)$  of the control data and monitoring timer  $((s2)+1)$  of the request frame so that the arrival monitoring time  $\geq$  monitoring timer.



### Point

This instruction is successfully completed even if the target device returns an abnormal response. When this instruction is completed successfully, the response is whether normal or abnormal can be identified by the end code of the response frame. When an abnormal response is returned, check the manual of the SLMP-compatible device being used and take corrective action.

## Operation error

| Error code (SD0) | Description                                                                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1193H            | Different channels where serial numbers are given, having the same own station port number                                                                  |
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port.                                                                     |
| 3285H            | The value set to $(s1)+2$ as own station channel is out of the range, 1 to 9.<br>The value set to $(s2)+0$ as the request data length is 0 or exceeds 2000. |

Upon completion with an error, the completion status indication device  $(d2)+1$  is turned on and an error code is stored in the completion status  $(s1)+1$ . For the error code stored in the completion status  $(s1)+1$ , refer to the following.

User's manual for the controller used

# 29.5 File Transfer Function Instructions

29

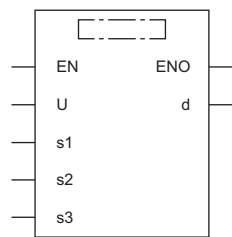
## Sending FTP client files

### GP.FTPCPUT, SP.FTPPUT

Sends files in the controller, which are specified by (s2), to the folder path of the FTP server, which is specified by (s3).

| Ladder | ST                                                                    |
|--------|-----------------------------------------------------------------------|
|        | ENO:=GP_FTPCPUT(EN,U,s1,s2,s3,d);<br>ENO:=SP_FTPPUT(EN,U,s1,s2,s3,d); |

### FBD/LD



### Execution condition

| Instruction             | Execution condition |
|-------------------------|---------------------|
| GP.FTPCPUT<br>SP.FTPPUT |                     |

### Setting data

### Description, range, data type

| Operand |            | Description                                                                                                                                | Range                      | Data type                    | Data type (label)                       |
|---------|------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------|-----------------------------------------|
| (U)     | GP.FTPCPUT | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number)                                                       | 3E0H                       | 16-bit unsigned binary       | ANY16                                   |
|         | SP.FTPPUT  | Dummy                                                                                                                                      | —                          | String                       | ANYSTRING_SINGLE                        |
| (s1)    | GP.FTPCPUT | Start device where control data is stored                                                                                                  | Refer to the control data. | Device                       | ANY16                                   |
|         | SP.FTPPUT  |                                                                                                                                            |                            | Word                         | ANY16_ARRAY<br>(Number of elements: 4)  |
| (s2)    |            | Name of files stored in the controller (transfer source)* <sup>1</sup>                                                                     | —                          | Unicode string* <sup>2</sup> | ANYSTRING_DOUBLE                        |
| (s3)    |            | Folder path of the FTP server (transfer destination)* <sup>1</sup>                                                                         | —                          | Unicode string* <sup>2</sup> | ANYSTRING_DOUBLE                        |
| (d)     |            | Device that turns on for one scan upon completion of the instruction<br>When the instruction completes with an error, (d)+1 also turns on. | —                          | Bit                          | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      |            | Execution condition                                                                                                                        | —                          | Bit                          | BOOL                                    |
| ENO     |            | Execution result                                                                                                                           | —                          | Bit                          | BOOL                                    |

\*1 Unicode string or the start device where the Unicode string is stored

\*2 Even though the data type is Unicode string, only one-byte alphanumeric characters, symbols, and kana characters; and two-byte characters (Shift JIS codes) can be used. Unsupported characters are treated as "\_".

## ■Applicable devices

| Operand | Bit                              |     | Word                                  |            |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|-----|---------------------------------------|------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | ○        | — | —  | ○          |
| (s1)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | —  | —          |
| (s2)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —          |
| (s3)    | —                                | —   | ○                                     | —          | — | —           | —  | ○                      | —        | — | ○  | —          |
| (d)     | ○                                | —   | ○*1                                   | —          | — | —           | —  | ○                      | —        | — | —  | —          |

\*1 T, ST, C, and FD cannot be used.

## ■Control data

| Operand: (s1) |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                    |        |
|---------------|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------|
| Device        | Item                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Setting range                      | Set by |
| +0            | Application setting area                | <div> <div> <div>b15</div> <div>...</div> <div>b3 b2 b1 b0</div> </div> <div> <div>0</div> <div>(2)</div> <div>(1)</div> <div>0</div> </div> </div> <p>(1) Transfer completion file delete setting (b2)<br/>Specify whether to delete transfer completion files or not.</p> <ul style="list-style-type: none"> <li>• 0: Do not delete</li> <li>• 1: Delete</li> </ul> <p>(2) Temporary file create setting (b3)<br/>Specify whether to create a temporary file (transfer source file name including extension.TMP) during the file transfer processing or not.<br/>Setting this bit to 0 prevents files from becoming undefined in the transfer destination when a cable is disconnected or power is shut off during the file transfer processing.</p> <ul style="list-style-type: none"> <li>• 0: Create</li> <li>• 1: Do not create</li> </ul> | Refer to the "Description" column. | User   |
| +1            | Completion status                       | <p>The completion status is stored upon completion of the instruction.</p> <ul style="list-style-type: none"> <li>• 0000H: Completed successfully</li> <li>• Other than 0000H: Completed with an error (error code)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | —                                  | System |
| +2            | Total number of files to be transferred | The total number of files to be transferred by this instruction is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | —                                  | System |
| +3            | Number of transferred files             | The number of transferred files is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | —                                  | System |

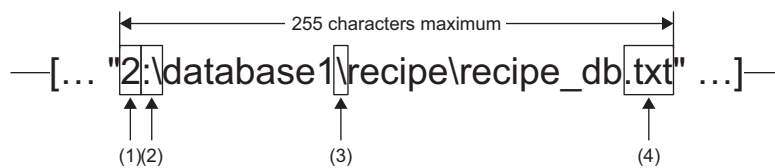
## Processing details

- Sends files in the controller, which are specified by (s2), to the folder path of the FTP server, which is specified by (s3). The controller opens a connection with the FTP server set in the module parameters ("FTP Client Settings") at execution of this instruction, and closes a connection after sending files. For details on the parameter setting, refer to the following.

User's manual for the controller used

- The total number of files to be transferred by this instruction is stored in (s1)+2, and the number of transferred files is stored in (s1)+3.
- Specify the transfer source drive number (2 to 4, or 6) of the controller, the folder path where the files are stored, and the file name (including a period and an extension) in (s2) in Unicode string in 64 characters or less. The maximum number of characters used in a file path is 255. The maximum number of characters used in a path, excluding the file name, is 246 (not including a delimiter). Use one-byte '\' or '/' as a delimiter to specify the boundaries between the elements in a file path.

\*1



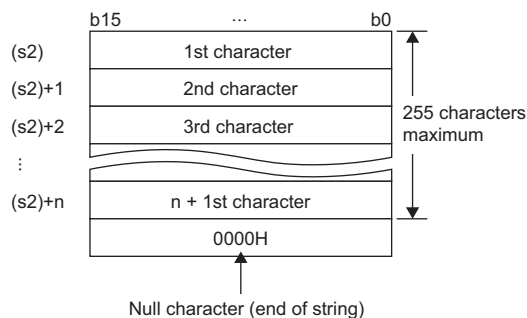
(1) Drive numbers that can be specified are 2 to 4, or 6. ( User's manual for the controller used)

(2) Use one-byte '\' or '/' as a delimiter of the drive number.

(3) Use one-byte '\' or '/' as a delimiter of the folder path and file.

(4) The specified file name should include an extension.

\*1 A relative path cannot be specified for the FTP client path.



- Wild card characters (\*, ?) can be used in the file name or the extension specified in (s2).

| Symbol | Description                                                                                                         |
|--------|---------------------------------------------------------------------------------------------------------------------|
| *      | An asterisk '*' is replaced with any character or string (including none) in a file name.                           |
| ?      | A question mark '?' is replaced with a character (excluding none) in a file name. ('?' can be used multiple times.) |

Wild card characters do not recognize periods.

Using wild card characters in the following ways results in an error.

- Two or more asterisks '\*\*' are used in a file name (before the period) or an extension. (Example: \*abc\*.txt)
- An asterisk '\*' and a question mark '?' are used in a file name (before the period) or an extension. (Example: \*ab?.txt)

When any wild card character is used, the number of files that can be transferred is determined by the total size of the file names of the specified files. The specified files can be transferred when the number of these files and the total size of the file names satisfy the following condition. If a file transfer function instruction is executed without satisfying the following condition, the instruction completes with an error.

$$(F_i + N \cdot M) + 1 < 65536 \text{ [bytes]}$$

N: Total number of files that match the wild card specification

F<sub>i</sub>: Total size of the file names that match the wild card specification

M: Specific information size (Fixed value: 6 bytes)

- If an error occurs in any one of the files to be transferred during execution of this instruction, the transfer processing will be stopped upon detection of the error, and the rest of the target files will not be transferred.
- Untransferable files will not be transferred even though the wild card specification conditions are satisfied.
- If the number of characters in the file path which includes a file name and an extension exceeds 255, files will not be transferred even though the wild card specification conditions are satisfied.

- Specify the folder path of the transfer destination FTP server in (s3) in Unicode string. The specified folder path shall be a relative path from home directory of the FTP server. Use one-byte '\' or '/' as a delimiter to specify the boundary of the folder path. \*1 The maximum number of characters used in the folder path is 255. Note that the total number of characters in a folder path (including the delimiter at the end) and the file name specified in (s2) must be within the maximum path length supported by the transfer destination FTP server. The delimiter at the end of a string can be omitted. When omitted, '\' is assumed to be set at the end. If a nonexistent folder path is specified, a folder is automatically created by the system at execution of the instruction, and then the processing is performed. \*2

—[... "\database1\recipe\" ...]—

(1) (2)

(1) Use one-byte '\' or '/' as a delimiter to specify the boundary of the folder path. \*3

(2) The delimiter at the end of string can be omitted.

\*2 FTP server drive cannot be specified.

\*3 Note that '\' cannot be used as a delimiter for some FTP servers.

- If a NULL character is specified by (s3) or only "0000H" is specified for the device, the controller directly accesses under the home directory of the FTP server. For details, follow the FTP server specifications.
- If a file with the same name exists in the transfer destination, the file will be overwritten.
- The maximum size of a file that can be sent is 4G bytes.
- The execution status and the completion status of this instruction can be checked with the completion device (d) specified by the setup data and the completion status indication device (d)+1.

• Completion device (d)

This device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

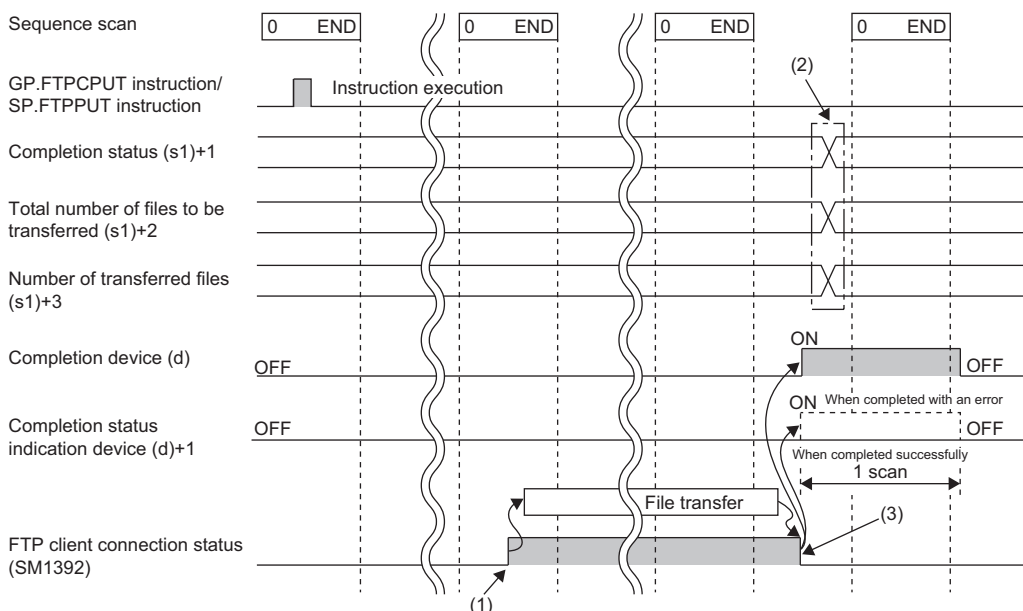
• Completion status indication device (d)+1

This device turns on or off depending on the completion status of this instruction.

Completed successfully: The device remains off.

Completed with an error: The device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing. In addition, an error code is stored in the device specified by (s1)+1.

- The following figure shows the execution timing of this instruction.



(1) SM1392 turns on during the END processing after the controller is connected to the FTP server.

(2) Values are stored upon completion of the instruction.

(3) When all files have been transferred, SM1392 turns off.



- SM1392 (FTP client connection status) is on while the controller is connected to the FTP server, and SM1392 turns off when disconnected.
- SM753 (File being accessed) turns on while this instruction is being executed. While SM753 is on, this instruction cannot be executed. If executed, no processing is performed.
- If this instruction is executed while this instruction, GP.FTPCGET instruction or SP.FTPGET instruction is being executed, the instruction is ignored and not executed until the currently executing instruction completes. When this instruction is ignored, SM699 (Dedicated instruction skip flag) turns on.
- In the following cases, the instruction completes with an error: when there is no free space in the transfer destination; or when b3 (Temporary file create setting) of (s1)+0 is set to 0 (Create), but there is not enough free space for storing transfer-target files and a temporary file (same size as transfer-target files) in the transfer destination.
- Even though the operating status of the controller is switched RUN to STOP during the file transfer processing, the controller continues the processing until completed.

## Precautions

- If a cable is disconnected, power is shut off, or the controller is reset during the file transfer processing, delete unnecessary files (such as a temporary file and undefined files) on the FTP server as needed. Then, transfer files again.
- When b2 (Transfer completion file delete setting) of (s1)+0 is set to 1 (Delete), note the following.

| Item                                                      | Description                                                                                                                   |
|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| When files in the controller are transferred              | Files required for the controller to operate are also deleted. If deleted, operations of the controller cannot be guaranteed. |
| When wild card characters are used to specify a file name | Required files may be deleted unintentionally.                                                                                |

- When transfer source file access is restricted by the file password function, this instruction completes with an error. Note, however, that this instruction can be executed if b2 (Transfer completion file delete setting) of (s1)+0 is set to 0 (Do not delete) and the file password setting type is "Write Protection".
- When b3 (Temporary file create setting) of (s1)+0 is set to 0 (Create), a temporary file of up to 68 characters (transfer source file name including period and extension.TMP) will be created in the transfer destination. Therefore, set the transfer destination folder path so that the total number of characters in the folder path and the temporary file does not exceed the maximum path length supported by the destination FTP server.
- Do not use any unsupported characters. If an unsupported character is included in the file name or the folder name specified by (s2) and (s3), the character is converted to "\_" and processed. When wild card characters are used and an unsupported character is included in the name of files stored in the transfer source controller, the character is converted to "\_" and processed. For this reason, the corresponding file is transferred in the same way as files having the same file name or folder name after character conversion are transferred.

## Operation error

| Error code (SD0) | Description                                                                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port.                                                                     |
| 2820H            | There is no NULL code (0000H) in the assignment range of the relevant device/label for the device number specified by (s2), (s3), and later.                |
| 3285H            | The number of characters in the string specified by (s2) exceeds 255.                                                                                       |
|                  | The number of characters in the path specified by (s2), excluding the file name, exceeds 246 (not including a delimiter).                                   |
|                  | The total number of characters in the strings specified by (s2) (only the file name part, excluding the drive number and folder path) and (s3) exceeds 255. |
|                  | The drive number specified by (s2) is out of range.                                                                                                         |
|                  | The number of characters of the file name specified by (s2) exceeds 64.                                                                                     |
| 3296H            | A file name is not specified by (s2).                                                                                                                       |
|                  | The file name that cannot be transferred is specified by (s2).                                                                                              |
|                  | The delimiter used to separate the drive number in (s2) is neither ':' nor '/'.                                                                             |
|                  | Two or more asterisks '*' are used in the file name (before the period) or the extension specified by (s2).                                                 |
|                  | An asterisk '*' and a question mark '?' are used in the file name (before the period) or the extension specified by (s2).                                   |
| 329BH            | Wild card characters, '*' and '?', are used in the string specified by (s3).                                                                                |
|                  | This instruction was executed without setting FTP client parameters.                                                                                        |

Upon completion with an error, the completion status indication device (d)+1 is turned on and an error code is stored in the completion status (s1)+1.

For the error code stored in the completion status (s1)+1, refer to the following.

 User's manual for the controller used

# Retrieving FTP client files

29

## GP.FTPCGET, SP.FTPGET

Retrieves files on the FTP server, which are specified by (s2), to the folder path of the controller, which is specified by (s3).

| Ladder | ST                                                                            |
|--------|-------------------------------------------------------------------------------|
|        | <pre>ENO:=GP_FTPCGET(EN,U,s1,s2,s3,d); ENO:=SP_FTPGET(EN,U,s1,s2,s3,d);</pre> |

| FBD/LD |
|--------|
|        |

### Execution condition

| Instruction             | Execution condition |
|-------------------------|---------------------|
| GP.FTPCGET<br>SP.FTPGET |                     |

### Setting data

### Description, range, data type

| Operand |            | Description                                                                                                                                    | Range                      | Data type                    | Data type (label)                       |
|---------|------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------|-----------------------------------------|
| (U)     | GP.FTPCGET | Start I/O number of target<br>(Specifies the first 3 digits of the start I/O number)                                                           | 3E0H                       | 16-bit unsigned binary       | ANY16                                   |
|         | SP.FTPGET  | Dummy                                                                                                                                          | —                          | String                       | ANYSTRING_SINGLE                        |
| (s1)    | GP.FTPCGET | Start device where control data is stored                                                                                                      | Refer to the control data. | Device                       | ANY16                                   |
|         | SP.FTPGET  |                                                                                                                                                |                            | Word                         | ANY16_ARRAY<br>(Number of elements: 4)  |
| (s2)    |            | Name of files stored in the FTP server (transfer source)* <sup>1</sup>                                                                         | —                          | Unicode string* <sup>2</sup> | ANYSTRING_DOUBLE                        |
| (s3)    |            | Folder path of the controller (transfer destination)* <sup>1</sup>                                                                             | —                          | Unicode string* <sup>2</sup> | ANYSTRING_DOUBLE                        |
| (d)     |            | Device that turns on for one scan upon completion of the instruction<br><br>When the instruction completes with an error, (d)+1 also turns on. | —                          | Bit                          | ANYBIT_ARRAY<br>(Number of elements: 2) |
| EN      |            | Execution condition                                                                                                                            | —                          | Bit                          | BOOL                                    |
| ENO     |            | Execution result                                                                                                                               | —                          | Bit                          | BOOL                                    |

\*1 Unicode string or the start device where the Unicode string is stored

\*2 Even though the data type is Unicode string, only one-byte alphanumeric characters, symbols, and kana characters; and two-byte characters (Shift JIS codes) can be used. Unsupported characters are treated as "\_".

## ■Applicable devices

| Operand | Bit                              |      | Word                                  |             |   | Double word |    | Indirect specification | Constant |   |    | Others (U) |
|---------|----------------------------------|------|---------------------------------------|-------------|---|-------------|----|------------------------|----------|---|----|------------|
|         | X, Y, M, L, SM, F, B, SB, FX, FY | J□□□ | T, ST, C, D, W, SD, SW, FD, R, ZR, RD | U□\G□, J□\□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |            |
| (U)     | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | ○        | — | —  | ○          |
| (s1)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | —  | —          |
| (s2)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —          |
| (s3)    | —                                | —    | ○                                     | —           | — | —           | —  | ○                      | —        | — | ○  | —          |
| (d)     | ○                                | —    | ○*1                                   | —           | — | —           | —  | ○                      | —        | — | —  | —          |

\*1 T, ST, C, and FD cannot be used.

## ■Control data

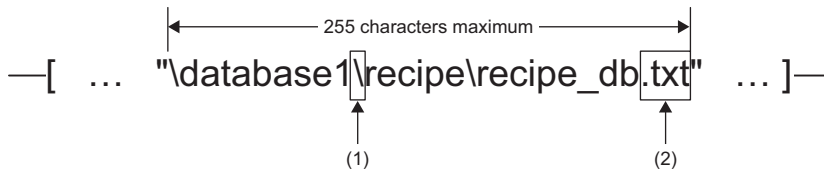
| Operand: (s1) |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                    |        |
|---------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------|
| Device        | Item                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Setting range                      | Set by |
| +0            | Application setting area                | <div> <div> <div>b15</div> <div>...</div> <div>b3</div> <div>b2</div> <div>b1</div> <div>b0</div> </div> <div> <div>0</div> <div>(2)</div> <div>(1)</div> <div>0</div> </div> </div> <p>(1) Transfer completion file delete setting (b2)<br/>Specify whether to delete transfer completion files or not.</p> <ul style="list-style-type: none"> <li>• 0: Do not delete</li> <li>• 1: Delete</li> </ul> <p>(2) Temporary file create setting (b3)<br/>Specify whether to create a temporary file (transfer source file name including extension.TMP) during the file transfer processing or not.<br/>Setting this bit to 0 prevents files from becoming undefined in the transfer destination when a cable is disconnected or power is shut off during the file transfer processing.</p> <ul style="list-style-type: none"> <li>• 0: Create</li> <li>• 1: Do not create</li> </ul> | Refer to the "Description" column. | User   |
| +1            | Completion status                       | <p>The completion status is stored upon completion of the instruction.</p> <ul style="list-style-type: none"> <li>• 0000H: Completed successfully</li> <li>• Other than 0000H: Completed with an error (error code)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | —                                  | System |
| +2            | Total number of files to be transferred | The total number of files to be transferred by this instruction is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | —                                  | System |
| +3            | Number of transferred files             | The number of transferred files is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | —                                  | System |

## Processing details

- Retrieves files on the FTP server, which are specified by (s2), to the folder path of the controller, which is specified by (s3). The controller opens a connection with the FTP server set in the module parameters ("FTP Client Settings") at execution of this instruction, and closes a connection after retrieving files. For details on the parameter setting, refer to the following.

📖 User's manual for the controller used

- The total number of files to be transferred by this instruction is stored in (s1)+2, and the number of transferred files is stored in (s1)+3.
- Specify the folder path where the transfer source files are stored on the FTP server, and the file names (including a period and an extension) in (s2) in Unicode string in 64 characters or less. The maximum number of characters used in a file path is 255. The specified file path shall be a relative path from home directory of the FTP server. Use one-byte '\' or '/' as a delimiter to specify the boundaries between the folder path and the file name. \*1\*2

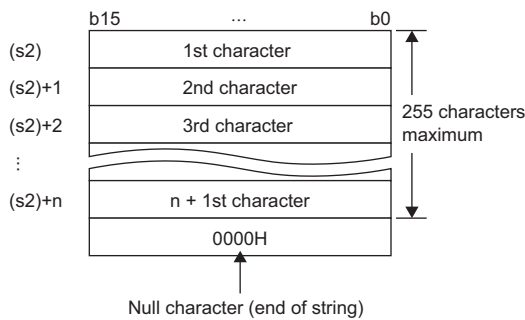


(1) Use one-byte '\' or '/' as a delimiter of the folder path or file.\*2

(2) The specified file name should include an extension.

\*1 FTP server drive cannot be specified.

\*2 Note that '\' cannot be used as a delimiter for some FTP servers.



- Wild card characters (\*, ?) can be used in the file name or the extension specified in (s2).

| Symbol | Description                                                                                                         |
|--------|---------------------------------------------------------------------------------------------------------------------|
| *      | An asterisk '*' is replaced with any character or string (including none) in a file name.                           |
| ?      | A question mark '?' is replaced with a character (excluding none) in a file name. ('?' can be used multiple times.) |

Wild card characters do not recognize periods.

Using wild card characters in the following ways results in an error.

- Two or more asterisks '\*\*' are used in a file name (before the period) or an extension. (Example: \*abc\*.txt)
- An asterisk '\*' and a question mark '?' are used in a file name (before the period) or an extension. (Example: \*ab?.txt)

Files in the subfolder cannot be transferred.

When any wild card character is used, files to be retrieved differ depending on the FTP server environment. Check the operating specifications of the FTP server.

When any wild card character is used, the number of files that can be transferred is determined by the total size of the file names of the specified files. The specified files can be transferred when the number of these files and the total size of the file names satisfy the following condition. If a file transfer function instruction is executed without satisfying the following condition, the instruction completes with an error.

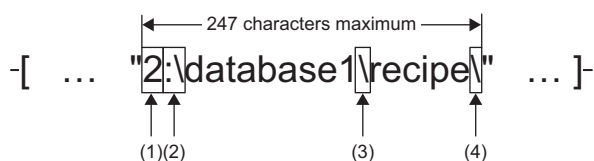
$(Fi + NM) + 1 < 65536$  [bytes]

N: Total number of files that match the wild card specification

Fi: Total size of the file names that match the wild card specification

M: Specific information size (Fixed value: 6 bytes)

- If an error occurs in any one of the files to be retrieved during execution of this instruction, the transfer processing will be stopped upon detection of the error, and the rest of the target files will not be transferred.
- Untransferable files will not be transferred even though the wild card specification conditions are satisfied.
- If the number of characters in the file path which includes a file name and an extension exceeds 255, files will not be transferred even though the wild card specification conditions are satisfied.
- If only a file name is specified by (s2), the controller directly accesses under the home directory of the FTP server. When specifying only a file name, start with a delimiter. For details, follow the FTP server specifications.
- Specify the folder path of the transfer destination of the controller in (s3) in Unicode string. Use one-byte '\' or '/' as a delimiter to specify the boundary of the folder path. The maximum number of characters in the folder path is 247 (246 when a delimiter at the end of the string is omitted). Note that the total number of characters in a folder path (including the delimiter at the end) and the file name specified in (s2) must be within the maximum path length (255 characters) supported by the controller. The delimiter at the end of a string can be omitted. When omitted, '\' is assumed to be set at the end. If a nonexistent folder path is specified, a folder is automatically created by the system at execution of the instruction, and then the processing is performed. \*3



- (1) Drive numbers that can be specified are 2 to 4. (User's manual for the controller used)  
 (2) Use one-byte '\' or '/' as a delimiter of the drive number.  
 (3) Use one-byte '\' or '/' as a delimiter to specify the boundary of the folder path.  
 (4) The delimiter at the end of string can be omitted.

\*3 A relative path cannot be specified for the FTP client path.

- If a file with the same name exists in the transfer destination, the file will be overwritten.
- The maximum size of a file that can be retrieved is 4G bytes.
- The execution status and the completion status of this instruction can be checked with the completion device (d) specified by the setup data and the completion status indication device (d)+1.

- Completion device (d)

This device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing.

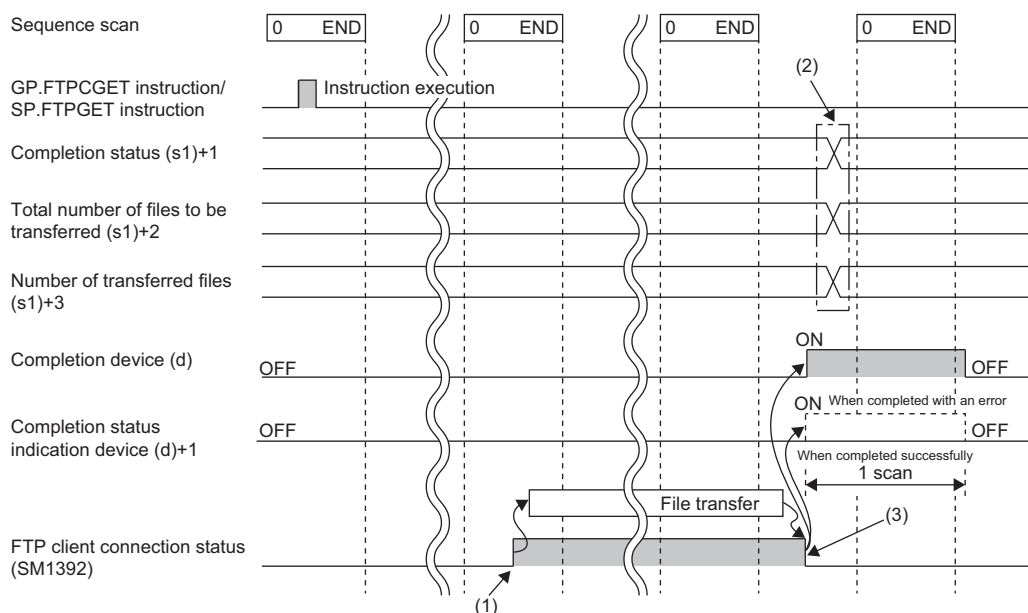
- Completion status indication device (d)+1

This device turns on or off depending on the completion status of this instruction.

Completed successfully: The device remains off.

Completed with an error: The device turns on during END processing of the scan where this instruction completes, and turns off during the next END processing. In addition, an error code is stored in the device specified by (s1)+1.

- The following figure shows the execution timing of this instruction.



- (1) SM1392 turns on during the END processing after the controller is connected to the FTP server.  
 (2) Values are stored upon completion of the instruction.  
 (3) When all files have been transferred, SM1392 turns off.

- SM1392 (FTP client connection status) is on while the controller is connected to the FTP server, and SM1392 turns off when disconnected.
- SM753 (File being accessed) turns on while this instruction is being executed. While SM753 is on, this instruction cannot be executed. If executed, no processing is performed.
- If this instruction is executed while GP.FTPCPUT instruction, SP.FTPPUT instruction, or this instruction is being executed, the instruction is ignored and not executed until the currently executing instruction completes. When this instruction is ignored, SM699 (Dedicated instruction skip flag) turns on.
- In the following cases, the instruction completes with an error: when there is no free space in the transfer destination; or when b3 (Temporary file create setting) of (s1)+0 is set to 0 (Create), but there is not enough free space for storing transfer-target files and a temporary file (same size as transfer-target files) in the transfer destination.
- Even though the operating status of the controller is switched RUN to STOP during the file transfer processing, the controller continues the processing until completed.

## Precautions

- If a cable is disconnected, power is shut off, or the controller is reset during the file transfer processing, transfer files again. In those cases, unnecessary files will be deleted in the following ways.

| Unnecessary file                                                   | Delete operation                                                                                                                        |
|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Temporary file (transfer source file name including extension.TMP) | A temporary file left in the FTP client will be automatically deleted at the start of next file transfer processing to the same folder. |
| Undefined transfer target file                                     | An undefined transfer target file left in the FTP client will be overwritten during next file transfer processing to the same file.     |

- When a file with the same name has already existed in the transfer destination and its access is restricted by the file password function, this instruction completes with an error.
- When b3 (Temporary file create setting) of (s1)+0 is set to 0 (Create), set the maximum number of characters in the folder path of the controller to 243 (242 when a delimiter at the end of the string is omitted). Since a temporary file of up to 68 characters (transfer source file name including period and extension.TMP) is created in the transfer destination, set the transfer destination folder path so that the total number of characters in the folder path and the temporary file does not exceed the maximum path length (255 characters) supported by the controller.
- Do not use any unsupported characters. If an unsupported character is included in the file name or the folder name specified by (s2) and (s3), the character is converted to "\_" and processed. For this reason, the corresponding file is transferred in the same way as files having the same file name or folder name after character conversion are transferred. When wild card characters are used and an unsupported character is included in the name of files stored in the transfer source FTP server, files cannot be retrieved properly. (How to treat unsupported characters depends on the specifications of the FTP server.)

## Operation error

| Error code (SD0) | Description                                                                                                                                  |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 2802H            | The Ethernet function instruction is executed using the settings with no Ethernet port.                                                      |
| 2820H            | There is no NULL code (0000H) in the assignment range of the relevant device/label for the device number specified by (s2), (s3), and later. |
| 3285H            | The number of characters in the string specified by (s2) exceeds 255.                                                                        |
|                  | The number of characters in the path specified by (s2), excluding the file name, exceeds 246 (not including a delimiter).                    |
|                  | The total number of characters in the strings specified by (s3) and (s2) (only the file name part) exceeds 255.                              |
|                  | The drive number specified by (s3) is out of range.                                                                                          |
|                  | The number of characters of the file name specified by (s2) exceeds 64.                                                                      |
| 3296H            | A file name is not specified by (s2).                                                                                                        |
|                  | The file name that cannot be transferred is specified by (s2).                                                                               |
|                  | The delimiter used to separate the drive number in (s3) is neither ':' nor '/'.                                                              |
|                  | Two or more asterisks '**' are used in the file name (before the period) or the extension specified by (s2).                                 |
|                  | An asterisk '*' and a question mark '?' are used in the file name (before the period) or the extension specified by (s2).                    |
| 329BH            | Wild card characters, '**' and '?', are used in the string specified by (s3).                                                                |
|                  | This instruction was executed without setting FTP client parameters.                                                                         |

Upon completion with an error, the completion status indication device (d)+1 is turned on and an error code is stored in the completion status (s1)+1.

For the error code stored in the completion status (s1)+1, refer to the following.

 User's manual for the controller used



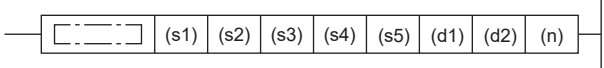
# 30 EXTERNAL DEVICE COMMUNICATION INSTRUCTIONS

30

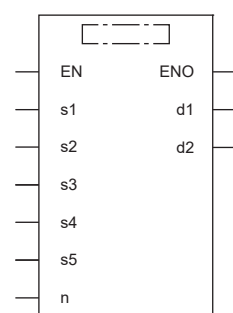
## 30.1 Special Adapter Instruction

### ADPRW

This instruction allows communications (read/write data) with slave stations using a function code supported by the master.

| Ladder                                                                            | Structured text                                |
|-----------------------------------------------------------------------------------|------------------------------------------------|
|  | ENO:=ADPRW(EN, s1, s2, s3, s4, s5, n, d1, d2); |

### FBD/LD



### Setting data

#### ■ Descriptions, ranges, and data types

| Operand | Description                                                                                                                                                                                | Range                | Data type                | Data type (label)                       |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------|-----------------------------------------|
| (s1)    | Slave station No.                                                                                                                                                                          | 0 to F7H             | 16-bit signed binary     | ANY16                                   |
| (s2)    | Function code (  Page 1216 Function codes and function parameters)                                      | 01H to 06H, 0FH, 10H | 16-bit signed binary     | ANY16                                   |
| (s3)    | Function parameters depending on the function code (  Page 1216 Function codes and function parameters) | 0 to FFFFH           | 16-bit signed binary     | ANY16                                   |
| (s4)    | Function parameters depending on the function code (  Page 1216 Function codes and function parameters) | 1 to 2000            | 16-bit signed binary     | ANY16                                   |
| (s5)    | Function parameters depending on the function code (  Page 1216 Function codes and function parameters) | —                    | Bit/16-bit signed binary | ANY_ELEMENTARY                          |
| (d1)    | Function parameters depending on the function code (  Page 1216 Function codes and function parameters) | —                    | Bit/16-bit signed binary | ANY_ELEMENTARY                          |
| (d2)*1  | Head bit device number to which the execution status of the communication is output                                                                                                        | —                    | Bit                      | ANYBIT_ARRAY<br>(Number of elements: 3) |
| (n)     | Communication channel                                                                                                                                                                      | 1 to 2               | 16-bit unsigned binary   | ANY16                                   |
| EN      | Execution condition                                                                                                                                                                        | —                    | Bit                      | BOOL                                    |
| ENO     | Execution result                                                                                                                                                                           | —                    | Bit                      | BOOL                                    |

\*1 Three devices are occupied from the device specified in (d2). Ensure that these devices are not used in other controls.

## ■Applicable devices

| Operand | Bit                                                                                     | Word                                  |                               |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|-----------------------------------------------------------------------------------------|---------------------------------------|-------------------------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, B, F, SB, V, T, ST, LT, LST, C, LC, L, FX, FY, SM, J□\X□, J□\Y□, J□\B□, J□\SB□ | T, ST, C, D, W, SW, FD, SD, R, ZR, RD | U□\G□, U3E□\G□, J□\W□, J□\SW□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s1)    | —                                                                                       | ○*1                                   | ○                             | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s2)    | —                                                                                       | ○*1                                   | ○                             | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s3)    | —                                                                                       | ○*1                                   | ○                             | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s4)    | —                                                                                       | ○*1                                   | ○                             | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (s5)    | ○                                                                                       | ○*1                                   | ○                             | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d1)    | ○                                                                                       | ○*1                                   | ○                             | ○ | —           | —  | ○                      | —        | — | —  | —      |
| (d2)    | ○                                                                                       | ○*1                                   | —                             | — | —           | —  | —                      | —        | — | —  | —      |
| (s5)    | ○*2                                                                                     | ○                                     | ○                             | — | —           | —  | ○                      | ○        | — | —  | —      |

\*1 T, ST, and C cannot be used.

\*2 FX and FY cannot be used.

## Processing details

- Function code (s2) is operated on Slave station No. (s1) according to Parameters (s3), (s4), (s5), and (d1). Use 0 as the Slave station No. (s1) for Broadcast commands. (Page 1216 Function codes and function parameters)
- The communication execution status (d2) is output according to the status of the ADPRW instruction such as communicating/completed normally/completed with an error. (Page 1218 Communication execution status output device)
- The ADPRW instruction is executed using the channel specified in the communication channel (n).

## ■Operations other than the normal execution

The operation during an online change differs depending on whether the program file to be rewritten contains a communicating instruction.

- Rewriting the program file containing a communicating instruction: The subsequent operations are taken over with the communication processing. Therefore, the MODBUS RTU communicating SM devices (SM8800, SM8810) remain 1 (communicating). Then, the MODBUS RTU communicating SM devices are turned off if the communication completes with the communication processing, also turned off during the instruction execution of the communication execution status output device, and turned on if the instruction completes with an error. Note that, when executing read commands, the read data is not stored in the devices. If the drive contact of the ADPRW instruction is turned off during at least one scan, the operation does not resume even if the contact turns on in later scans, unless the previous communication completes with the communication processing.
- Rewriting the other program file: The operation is continued.

## ■Function codes and function parameters

The parameter assignment of (s3), (s4), (s5), and (d1) by each function code (s2) is shown below.

| (s2): Function code | (s3): MODBUS address                                       | (s4): Access points         | (s5): Start device storing write data<br>(d1): Start device storing read data |                                                                                                                         |
|---------------------|------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
|                     | Target device: ② (Refer to the target device table below.) |                             |                                                                               |                                                                                                                         |
| 01H<br>Read coils   | MODBUS address:<br>0000H to FFFFH                          | Access points:<br>1 to 2000 | Start device storing read data                                                |                                                                                                                         |
|                     |                                                            |                             | Target device                                                                 | Word device<br>① (Refer to the target device table below.)<br>Bit device<br>③ (Refer to the target device table below.) |
|                     |                                                            |                             | Number of occupied points                                                     | Word device<br>((s4)+15)÷16 points*1<br>Bit device<br>(s4) points                                                       |

| (s2): Function code                     | (s3): MODBUS address                                       | (s4): Access points         | (s5): Start device storing write data<br>(d1): Start device storing read data |                                                                                                                         |
|-----------------------------------------|------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
|                                         | Target device: ❷ (Refer to the target device table below.) |                             |                                                                               |                                                                                                                         |
| 02H<br>Read inputs                      | MODBUS address:<br>0000H to FFFFH                          | Access points:<br>1 to 2000 | Start device storing read data                                                |                                                                                                                         |
|                                         |                                                            |                             | Target device                                                                 | Word device<br>❶ (Refer to the target device table below.)<br>Bit device<br>❸ (Refer to the target device table below.) |
|                                         |                                                            |                             | Number of occupied points                                                     | Word device<br>$((s4)+15) \div 16$ points* <sup>1</sup><br>Bit device<br>(s4) points                                    |
| 03H<br>Read holding registers           | MODBUS address:<br>0000H to FFFFH                          | Access points:<br>1 to 125  | Start device storing read data                                                |                                                                                                                         |
|                                         |                                                            |                             | Target device                                                                 | ❶ (Refer to the target device table below.)                                                                             |
|                                         |                                                            |                             | Number of occupied points                                                     | (s4) points                                                                                                             |
| 04H<br>Read input registers             | MODBUS address:<br>0000H to FFFFH                          | Access points:<br>1 to 125  | Start device storing read data                                                |                                                                                                                         |
|                                         |                                                            |                             | Target device                                                                 | ❶ (Refer to the target device table below.)                                                                             |
|                                         |                                                            |                             | Number of occupied points                                                     | (s4) points                                                                                                             |
| 05H<br>Write single coil                | MODBUS address:<br>0000H to FFFFH                          | Fixed to 0                  | Start device storing write data                                               |                                                                                                                         |
|                                         |                                                            |                             | Target device* <sup>2</sup>                                                   | Word device<br>❷ (Refer to the target device table below.)<br>Bit device<br>❸ (Refer to the target device table below.) |
|                                         |                                                            |                             | Number of occupied points                                                     | 1 point                                                                                                                 |
| 06H<br>Write holding register           | MODBUS address:<br>0000H to FFFFH                          | Fixed to 0                  | Start device storing write data                                               |                                                                                                                         |
|                                         |                                                            |                             | Target device                                                                 | ❷ (Refer to the target device table below.)                                                                             |
|                                         |                                                            |                             | Number of occupied points                                                     | 1 point                                                                                                                 |
| 0FH<br>Write multiple coils             | MODBUS address:<br>0000H to FFFFH                          | Access points:<br>1 to 1968 | Start device storing write data                                               |                                                                                                                         |
|                                         |                                                            |                             | Target device                                                                 | Word device<br>❷ (Refer to the target device table below.)<br>Bit device<br>❸ (Refer to the target device table below.) |
|                                         |                                                            |                             | Number of occupied points                                                     | Word device<br>$((s4)+15) \div 16$ points* <sup>1</sup><br>Bit device<br>(s4) points                                    |
| 10H<br>Write multiple holding registers | MODBUS address:<br>0000H to FFFFH                          | Access points:<br>1 to 123  | Start device storing write data                                               |                                                                                                                         |
|                                         |                                                            |                             | Target device                                                                 | ❷ (Refer to the target device table below.)                                                                             |
|                                         |                                                            |                             | Number of occupied points                                                     | (s4) points                                                                                                             |

\*1 The fraction is ignored.

\*2 The bit is turned off when the least significant bit is 0 and is turned on when the least significant bit is 1.

► Target device table

| No. | Target device                                                         |
|-----|-----------------------------------------------------------------------|
| ❶   | T, ST, C, D, R, W, SW, SD, LT, LST, LC, Z, LZ, ZR, label device       |
| ❷   | T, ST, C, D, R, W, SW, SD, LT, LST, LC, Z, LZ, ZR, label device, K, H |
| ❸   | X, Y, M, L, B, F, SB, SM, V, label device                             |

## ■Communication execution status output device

The following table lists the timing of operation of the communication execution status output device (d2) according to each communication status, as well as the special relays that operate simultaneously.

| Operand              | Timing of operation                                                    | Special relays that operate simultaneously |
|----------------------|------------------------------------------------------------------------|--------------------------------------------|
| (d2)                 | ON during instruction operation, OFF during other states               | SM8800 (CH1), SM8810 (CH2)                 |
| (d2)+1 <sup>*1</sup> | ON upon normal instruction completion, OFF at start of communication   | —                                          |
| (d2)+2 <sup>*1</sup> | ON upon abnormal instruction completion, OFF at start of communication | —                                          |

\*1 Normal and abnormal states can be distinguished as (d2)+1 turns on when the instruction is completed normally and (d2)+2 turns on when the instruction is completed abnormally.

## Precautions

- For the target channel to which the ADPRW instruction is to be used, configure the MODBUS master settings using GX Works3. Otherwise, the operation will not be performed even when the ADPRW instruction is executed. An operation error (error code: 3600H) will occur.
- When the program stops due to an error, the device value is turned off if a non-latch device is specified as the communication status output device. Specify a latch device if the communication status output needs to be retained.

## 30.2 Serial Communication 2

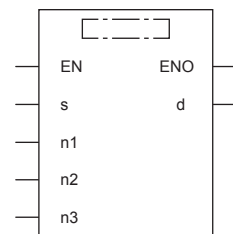
30

### RS2

This instruction sends/receives data by non-protocol communication via the communication adapter mounted on the controller.

| Ladder | Structured text                 |
|--------|---------------------------------|
|        | ENO:=RS2(EN, s, n1, n2, n3, d); |

### FBD/LD



### Setting data

#### ■Descriptions, ranges, and data types

| Operand | Description                      | Range     | Data type              | Data type (label) |
|---------|----------------------------------|-----------|------------------------|-------------------|
| (s)     | Head device storing send data    | —         | Word                   | ANY16             |
| (n1)    | Number of send data points       | 0 to 4096 | 16-bit unsigned binary | ANY16_U           |
| (d)     | Head device storing receive data | —         | Word                   | ANY16             |
| (n2)    | Number of receive data points    | 0 to 4096 | 16-bit unsigned binary | ANY16_U           |
| (n3)    | Communication channel            | K1, K2    | 16-bit unsigned binary | ANY16_U           |
| EN      | Execution condition              | —         | Bit                    | BOOL              |
| ENO     | Execution result                 | —         | Bit                    | BOOL              |

#### ■Applicable devices

| Operand | Bit                                                                                     | Word                                  |                               |   | Double word |    | Indirect specification | Constant |   |    | Others |
|---------|-----------------------------------------------------------------------------------------|---------------------------------------|-------------------------------|---|-------------|----|------------------------|----------|---|----|--------|
|         | X, Y, M, B, F, SB, V, T, ST, LT, LST, C, LC, L, FX, FY, SM, J□\X□, J□\Y□, J□\B□, J□\SB□ | T, ST, C, D, W, SW, FD, SD, R, ZR, RD | U□\G□, U3E□\G□, J□\W□, J□\SW□ | Z | LT, LST, LC | LZ |                        | K, H     | E | \$ |        |
| (s)     | —                                                                                       | ○ <sup>*1</sup>                       | —                             | — | —           | —  | ○                      | —        | — | —  | —      |
| (n1)    | ○ <sup>*2</sup>                                                                         | ○                                     | ○                             | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (d)     | —                                                                                       | ○ <sup>*1</sup>                       | —                             | — | —           | —  | ○                      | —        | — | —  | —      |
| (n2)    | ○ <sup>*2</sup>                                                                         | ○                                     | ○                             | ○ | —           | —  | ○                      | ○        | — | —  | —      |
| (n3)    | —                                                                                       | —                                     | —                             | — | —           | —  | —                      | ○        | — | —  | —      |

\*1 T, ST, and C cannot be used.

\*2 FX and FY cannot be used.

## Processing details

This instruction sends/receives data by non-protocol communication via the communication adapter mounted on the controller. This instruction specifies the head device storing the data sent from the controller, the number of data points, the head device storing the received data, and the maximum number of data points that can be received.

### ■Operations other than the normal execution

The operation during an online change differs depending on whether the program file to be rewritten contains a communicating instruction.

- Rewriting the program file containing a communicating instruction: The execution of the RS2 instruction is stopped.
- Rewriting the other program file: The operation is continued.

## Precautions

When changing the header, terminator, or timeout time, change them before driving the RS2 instruction (while it is off).

Changes are applied when the RS2 instruction is driven. Do not change the header, terminator, or timeout time while the RS2 instruction is being driven.

This part consists of the following chapters.

31 TYPE CONVERSION FUNCTIONS

---

32 SINGLE VARIABLE FUNCTIONS

---

33 ARITHMETIC OPERATION FUNCTIONS

---

34 BIT SHIFT FUNCTIONS

---

35 BOOLEAN FUNCTIONS

---

36 SELECTION FUNCTIONS

---

37 COMPARISON FUNCTIONS

---

38 STRING FUNCTIONS

---

39 TIME DATA TYPE FUNCTIONS

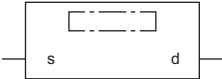
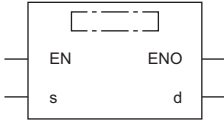
---

# 31 TYPE CONVERSION FUNCTIONS

## 31.1 Converting BOOL to WORD

### BOOL\_TO\_WORD(\_E)

These functions convert a value from BOOL data type to WORD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=BOOL_TO_WORD(s);<br>[With EN/ENO]<br>d:=BOOL_TO_WORD_E(EN,ENO,s); |
|  |  |                                                                                          |

#### Setting data

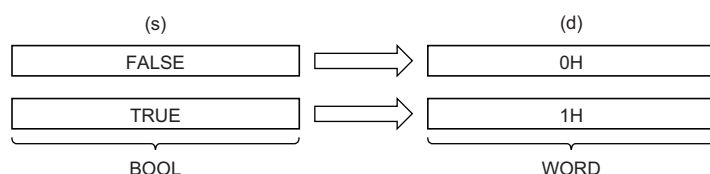
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | BOOL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | WORD      |

#### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from BOOL data type to WORD data type, and output the converted value from (d).
- When the input value is FALSE, 0H (WORD data type) is output.
- When the input value is TRUE, 1H (WORD data type) is output.



- Input a BOOL data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

#### Operation error

There is no operation error.

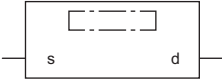
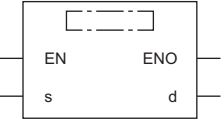


# 31.2 Converting BOOL to DWORD

31

## BOOL\_TO\_DWORD(\_E)

These functions convert a value from BOOL data type to DWORD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=BOOL_TO_DWORD(s);<br>[With EN/ENO]<br>d:=BOOL_TO_DWORD_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

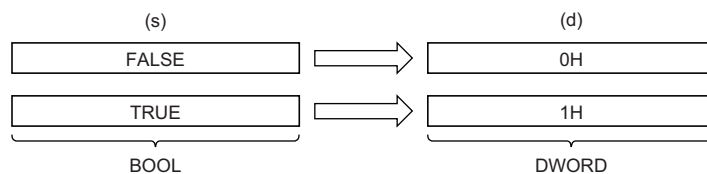
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | BOOL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DWORD     |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from BOOL data type to DWORD data type, and output the converted value from (d).
- When the input value is FALSE, 0H (DWORD data type) is output.
- When the input value is TRUE, 1H (DWORD data type) is output.



- Input a BOOL data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

There is no operation error.

# 31.3 Converting BOOL to INT

## BOOL\_TO\_INT(\_E)

These functions convert a value from BOOL data type to INT data type.

| Ladder, FBD/LD   |               | ST                                                                                     |
|------------------|---------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>d:=BOOL_TO_INT(s);<br>[With EN/ENO]<br>d:=BOOL_TO_INT_E(EN,ENO,s); |

### Setting data

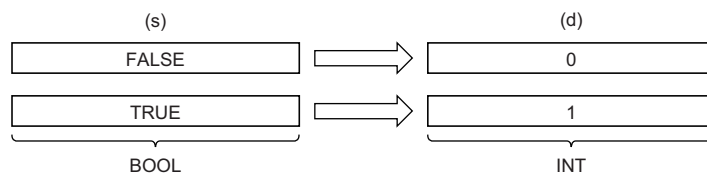
#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s (IN)   | Input                                                           | Input variable  | BOOL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d        | Output                                                          | Output variable | INT       |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from BOOL data type to INT data type, and output the converted value from (d).
- When the input value is FALSE, 0 (INT data type) is output.
- When the input value is TRUE, 1 (INT data type) is output.



- Input a BOOL data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

There is no operation error.

# 31.4 Converting BOOL to DINT

31

## BOOL\_TO\_DINT(\_E)

These instructions convert a value from BOOL data type to DINT data type.

| Ladder, FBD/LD   |               | ST                                                                                       |
|------------------|---------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>d:=BOOL_TO_DINT(s);<br>[With EN/ENO]<br>d:=BOOL_TO_DINT_E(EN,ENO,s); |

### Setting data

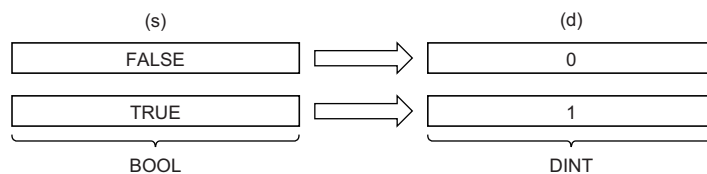
#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s (IN)   | Input                                                           | Input variable  | BOOL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d        | Output                                                          | Output variable | DINT      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from BOOL data type to DINT data type, and output the converted value from (d).
- When the input value is FALSE, 0 (DINT data type) is output.
- When the input value is TRUE, 1 (DINT data type) is output.



- Input a BOOL data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

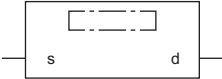
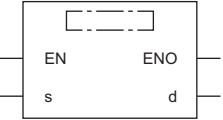
### Operation error

There is no operation error.

# 31.5 Converting BOOL to TIME

## BOOL\_TO\_TIME(\_E)

These functions convert a value from BOOL data type to TIME data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=BOOL_TO_TIME(s);<br>[With EN/ENO]<br>d:=BOOL_TO_TIME_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

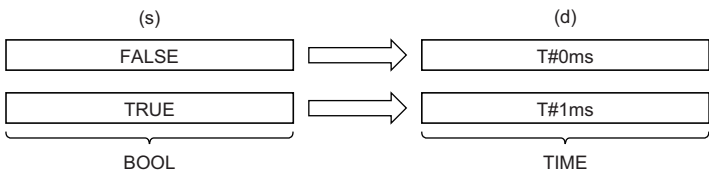
#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s (IN)   | Input                                                           | Input variable  | BOOL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d        | Output                                                          | Output variable | TIME      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from BOOL data type to TIME data type, and output the converted value from (d).
- When the input value is FALSE, 0 (TIME data type) is output.
- When the value is TRUE, 1 (TIME data type) is output.



- Input a BOOL data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  |                     | Operation result              |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

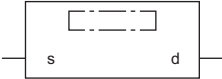
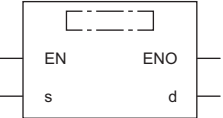
There is no operation error.

# 31.6 Converting BOOL to STRING

31

## BOOL\_TO\_STRING(\_E)

These functions convert a value from BOOL data type to STRING data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                           |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=BOOL_TO_STRING(s);<br>[With EN/ENO]<br>d:=BOOL_TO_STRING_E(EN,ENO,s); |
|  |  |                                                                                              |

### Setting data

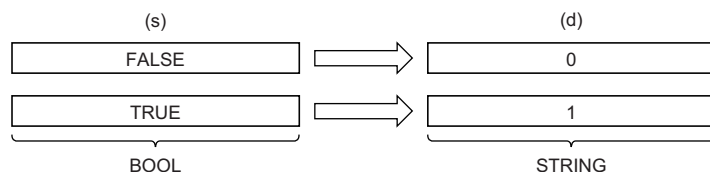
#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s (IN)   | Input                                                           | Input variable  | BOOL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d        | Output                                                          | Output variable | STRING    |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from BOOL data type to STRING data type, and output the converted value from (d).
- When the input value is FALSE, 0 (STRING data type) is output.
- When the input value is TRUE, 1 (STRING data type) is output.



- Input a BOOL data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

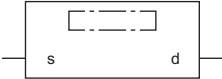
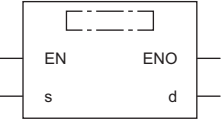
### Operation error

There is no operation error.

# 31.7 Converting WORD to BOOL

## WORD\_TO\_BOOL(\_E)

These functions convert a value from WORD data type to BOOL data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=WORD_TO_BOOL(s);<br>[With EN/ENO]<br>d:=WORD_TO_BOOL_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

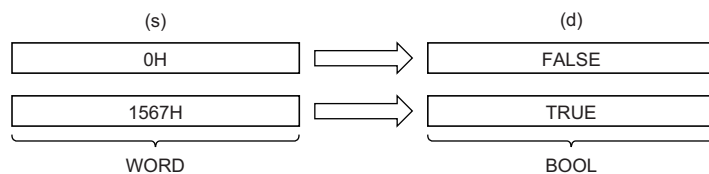
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | WORD      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | BOOL      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from WORD data type to BOOL data type, and output the converted value from (d).
- When the input value is 0H, FALSE is output.
- When the input value is other than 0H, TRUE is output.



- Input a WORD data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

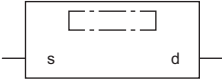
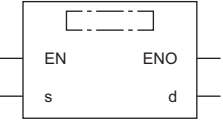
There is no operation error.

# 31.8 Converting WORD to DWORD

31

## WORD\_TO\_DWORD(\_E)

These functions convert a value from WORD data type to DWORD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=WORD_TO_DWORD(s);<br>[With EN/ENO]<br>d:=WORD_TO_DWORD_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

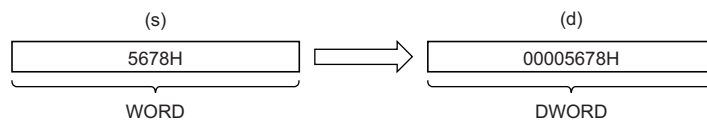
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | WORD      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DWORD     |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from WORD data type to DWORD data type, and output the converted value from (d).
- After the data type is converted, the upper 16 bits are filled with 0s.



- Input a WORD data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

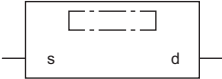
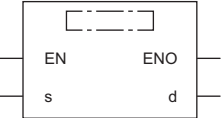
### Operation error

There is no operation error.

# 31.9 Converting WORD to INT

## WORD\_TO\_INT(\_E)

These functions convert a value from WORD data type to INT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=WORD_TO_INT(s);<br>[With EN/ENO]<br>d:=WORD_TO_INT_E(EN,ENO,s); |
|  |  |                                                                                        |

### Setting data

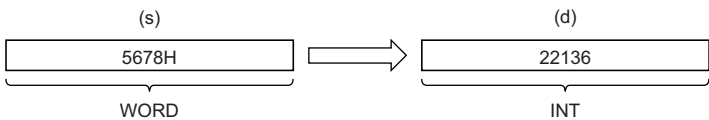
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | WORD      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | INT       |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from WORD data type to INT data type, and output the converted value from (d).



- Input a WORD data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

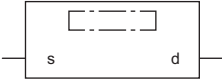
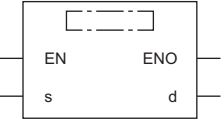
There is no operation error.



# 31.10 Converting WORD to DINT

## WORD\_TO\_DINT(\_E)

These functions convert a value from WORD data type to DINT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=WORD_TO_DINT(s);<br>[With EN/ENO]<br>d:=WORD_TO_DINT_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

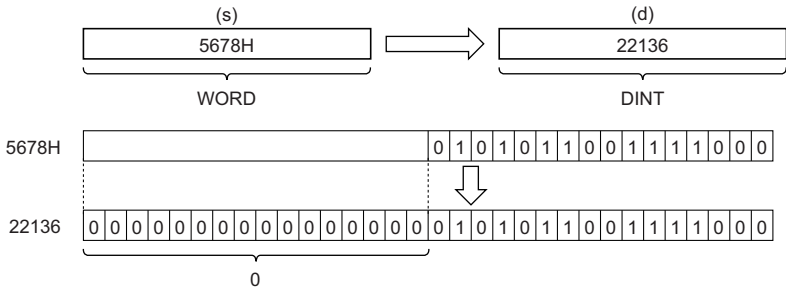
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | WORD      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DINT      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from WORD data type to DINT data type, and output the converted value from (d).
- After the data type is converted, the upper 16 bits are filled with 0s.



- Input a WORD data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

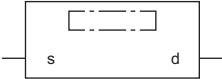
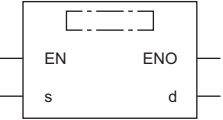
### Operation error

There is no operation error.

# 31.11 Converting WORD to TIME

## WORD\_TO\_TIME(\_E)

These functions convert a value from WORD data type to TIME data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=WORD_TO_TIME(s);<br>[With EN/ENO]<br>d:=WORD_TO_TIME_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

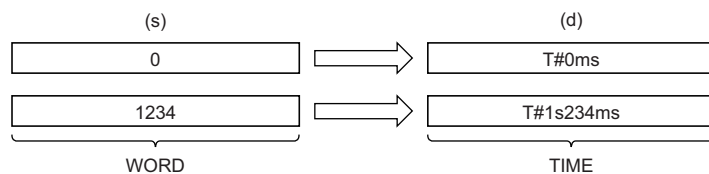
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | WORD      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | TIME      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from WORD data type to TIME data type, and output the converted value from (d).



- Input a WORD data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

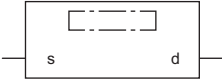
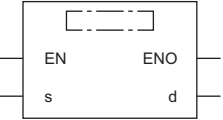
### Operation error

There is no operation error.

# 31.12 Converting WORD to STRING

## WORD\_TO\_STRING(\_E)

These functions convert a value from WORD data type to STRING data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                           |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=WORD_TO_STRING(s);<br>[With EN/ENO]<br>d:=WORD_TO_STRING_E(EN,ENO,s); |
|  |  |                                                                                              |

### Setting data

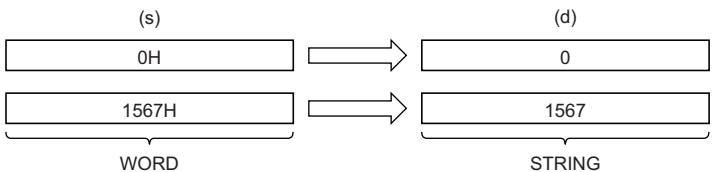
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | WORD      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | STRING(4) |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from WORD data type to STRING data type, and output the converted value from (d).



- Input a WORD data type value to (s).
- When SM701 (Number of output characters selection) is off, 00H is stored at the end of the string.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  |         | Operation result              |
|----------------------|---------|-------------------------------|
| EN                   | ENO     | (d)                           |
| TRUE (executed)      | TRUE    | Operation result output value |
| FALSE (not executed) | FALSE*1 | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

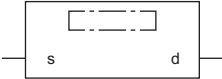
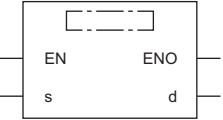
### Operation error

There is no operation error.

# 31.13 Converting DWORD to BOOL

## DWORD\_TO\_BOOL(\_E)

These functions convert a value from DWORD data type to BOOL data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DWORD_TO_BOOL(s);<br>[With EN/ENO]<br>d:=DWORD_TO_BOOL_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

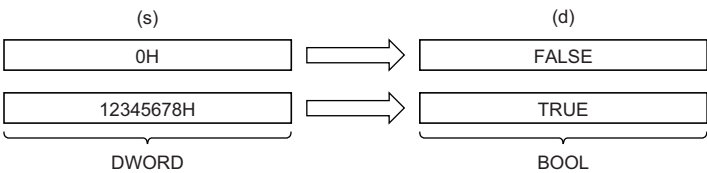
#### Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DWORD     |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | BOOL      |

### Processing details

#### Operation processing

- These functions convert the value input to (s) from DWORD data type to BOOL data type, and output the converted value from (d).
- When the input value is 0H, FALSE is output.
- When the input value is other than 0H, TRUE is output.



- Input a DWORD data type value to (s).

#### Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

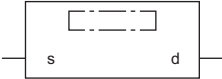
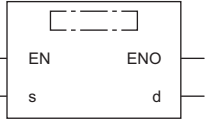
### Operation error

There is no operation error.

# 31.14 Converting DWORD to WORD

## DWORD\_TO\_WORD(\_E)

These functions convert a value from DWORD data type to WORD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DWORD_TO_WORD(s);<br>[With EN/ENO]<br>d:=DWORD_TO_WORD_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

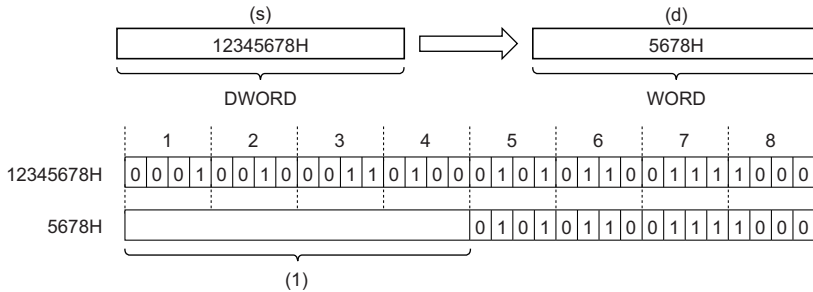
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DWORD     |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | WORD      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from DWORD data type to WORD data type, and output the converted value from (d).
- The upper 16-bit data of the input value (DWORD data type) are discarded. (Refer to (1) in the figure below.)



- Input a DWORD data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

#### Point

When the DWORD\_TO\_WORD(\_E) function is executed, the upper 16-bit data of the input value (DWORD data type) are discarded.

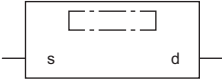
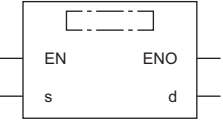
## Operation error

There is no operation error.

# 31.15 Converting DWORD to INT

## DWORD\_TO\_INT(\_E)

These functions convert a value from DWORD data type to INT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DWORD_TO_INT(s);<br>[With EN/ENO]<br>d:=DWORD_TO_INT_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

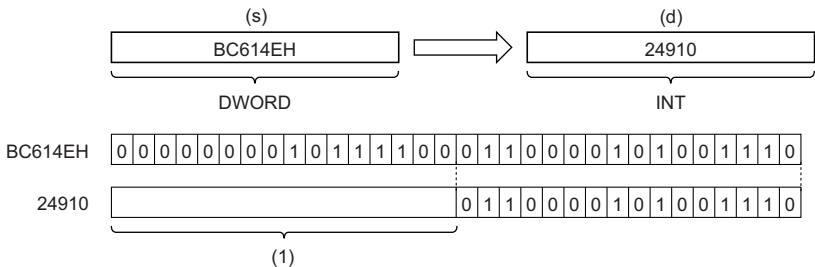
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DWORD     |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | INT       |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from DWORD data type to INT data type, and output the converted value from (d).
- The upper 16-bit data of the input value (DWORD data type) are discarded. (Refer to (1) in the figure below.)



- Input a DWORD data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

#### Point

When the DWORD\_TO\_INT(\_E) function is executed, the upper 16-bit data of the input value (DWORD data type) are discarded.

## Operation error

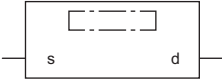
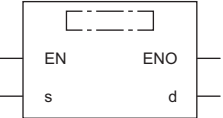
There is no operation error.



# 31.16 Converting DWORD to DINT

## DWORD\_TO\_DINT(\_E)

These functions convert a value from DWORD data type to DINT data type.

| Ladder, FBD/LD                                                                                        |                                                                                                    | ST                                                                                         |
|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]<br> | [With EN/ENO]<br> | [Without EN/ENO]<br>d:=DWORD_TO_DINT(s);<br>[With EN/ENO]<br>d:=DWORD_TO_DINT_E(EN,ENO,s); |

### Setting data

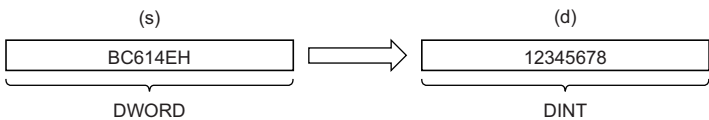
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DWORD     |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DINT      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from DWORD data type to DINT data type, and output the converted value from (d).



- Input a DWORD data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

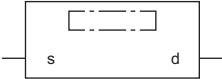
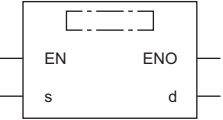
### Operation error

There is no operation error.

# 31.17 Converting DWORD to TIME

## DWORD\_TO\_TIME(\_E)

These functions convert a value from DWORD data type to TIME data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DWORD_TO_TIME(s);<br>[With EN/ENO]<br>d:=DWORD_TO_TIME_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

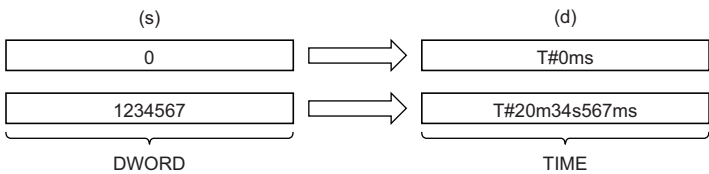
#### Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DWORD     |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | TIME      |

### Processing details

#### Operation processing

- These functions convert the value input to (s) from DWORD data type to TIME data type, and output the converted value from (d).



- Input a DWORD data type value to (s).

#### Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

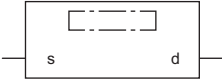
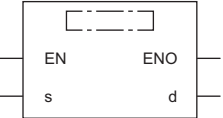
There is no operation error.

# 31.18 Converting DWORD to STRING

31

## DWORD\_TO\_STRING(\_E)

These functions convert a value from DWORD data type to STRING data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                             |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DWORD_TO_STRING(s);<br>[With EN/ENO]<br>d:=DWORD_TO_STRING_E(EN,ENO,s); |
|  |  |                                                                                                |

### Setting data

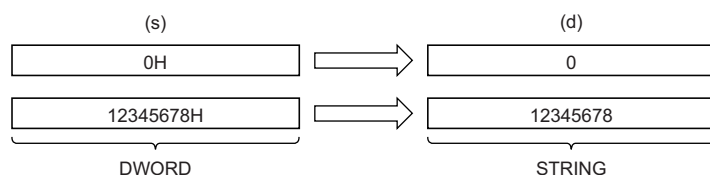
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DWORD     |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | STRING(8) |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from DWORD data type to STRING data type, and output the converted value from (d).



- Input a DWORD data type value to (s).
- When SM701 (Number of output characters selection) is off, 00H is stored at the end of the string.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

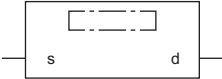
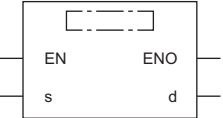
### Operation error

There is no operation error.

# 31.19 Converting INT to BOOL

## INT\_TO\_BOOL(\_E)

These functions convert a value from INT data type to BOOL data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=INT_TO_BOOL(s);<br>[With EN/ENO]<br>d:=INT_TO_BOOL_E(EN,ENO,s); |
|  |  |                                                                                        |

### Setting data

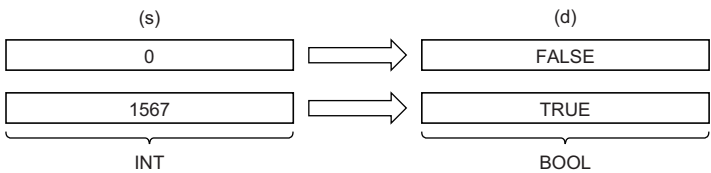
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | BOOL      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from INT data type to BOOL data type, and output the converted value from (d).
- When the value 0 is input, FALSE is output.
- When the value other than 0 is input, TRUE is output.



- Input an INT data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  |         | Operation result              |
|----------------------|---------|-------------------------------|
| EN                   | ENO     | (d)                           |
| TRUE (executed)      | TRUE    | Operation result output value |
| FALSE (not executed) | FALSE*1 | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

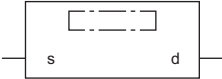
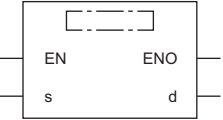
### Operation error

There is no operation error.

# 31.20 Converting INT to WORD

## INT\_TO\_WORD(\_E)

These functions convert a value from INT data type to WORD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=INT_TO_WORD(s);<br>[With EN/ENO]<br>d:=INT_TO_WORD_E(EN,ENO,s); |
|  |  |                                                                                        |

### Setting data

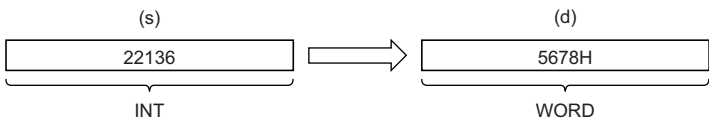
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | WORD      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from INT data type to WORD data type, and output the converted value from (d).



- Input an INT data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

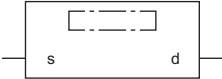
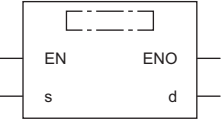
### Operation error

There is no operation error.

# 31.21 Converting INT to DWORD

## INT\_TO\_DWORD(\_E)

These functions convert a value from INT data type to DWORD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=INT_TO_DWORD(s);<br>[With EN/ENO]<br>d:=INT_TO_DWORD_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

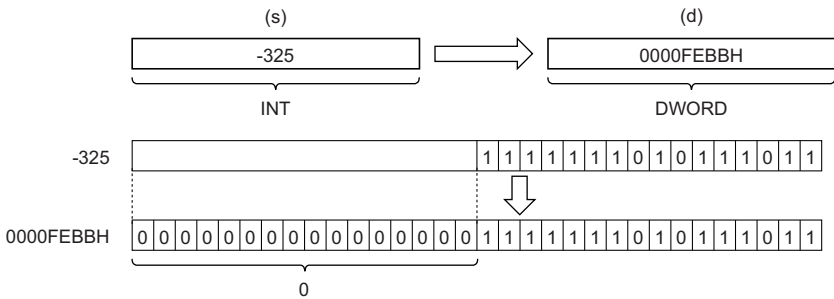
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DWORD     |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from INT data type to DWORD data type, and output the converted value from (d).
- After the data type is converted, the upper 16 bits are filled with 0s.



- Input an INT data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

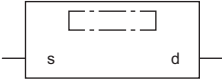
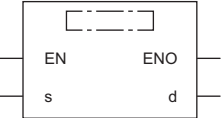
### Operation error

There is no operation error.

# 31.22 Converting INT to DINT

## INT\_TO\_DINT(\_E)

These functions convert a value from INT data type to DINT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=INT_TO_DINT(s);<br>[With EN/ENO]<br>d:=INT_TO_DINT_E(EN,ENO,s); |
|  |  |                                                                                        |

### Setting data

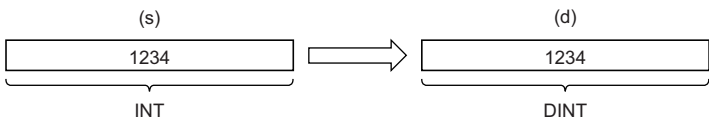
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DINT      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from INT data type to DINT data type, and output the converted value from (d).



- Input an INT data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

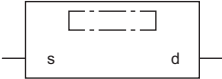
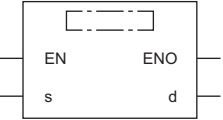
### Operation error

There is no operation error.

# 31.23 Converting INT to BCD

## INT\_TO\_BCD(\_E)

These functions convert a value from INT data type to BCD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=INT_TO_BCD(s);<br>[With EN/ENO]<br>d:=INT_TO_BCD_E(EN,ENO,s); |
|  |  |                                                                                      |

### Setting data

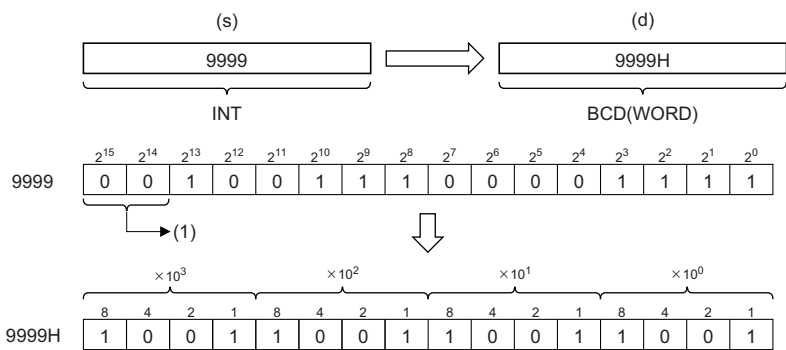
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | WORD      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from INT data type to BCD (WORD) data type, and output the converted value from (d).



(1) Make sure to set them to "0".

- Input an INT data type value to (s) within the range of 0 to 9999.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.



## Operation error

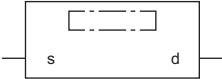
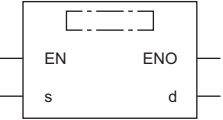
| Error code (SD0) | Description                                       |
|------------------|---------------------------------------------------|
| 3281H            | Data input to (s) is out of the range, 0 to 9999. |

31

# 31.24 Converting INT to REAL

## INT\_TO\_REAL(\_E)

These functions convert a value from INT data type to REAL data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=INT_TO_REAL(s);<br>[With EN/ENO]<br>d:=INT_TO_REAL_E(EN,ENO,s); |
|  |  |                                                                                        |

### Setting data

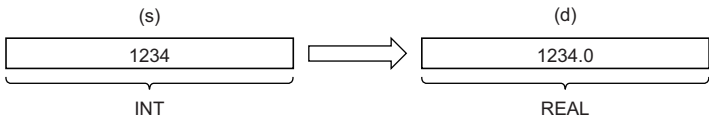
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | REAL      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from INT data type to REAL data type, and output the converted value from (d).



- Input an INT data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

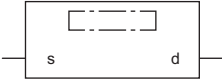
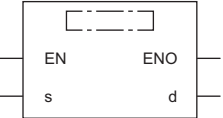
### Operation error

There is no operation error.

# 31.25 Converting INT to LREAL

## INT\_TO\_LREAL(\_E)

These functions convert a value from INT data type to LREAL data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=INT_TO_LREAL(s);<br>[With EN/ENO]<br>d:=INT_TO_LREAL_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

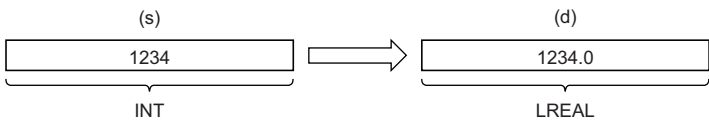
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | LREAL     |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from INT data type to LREAL data type, and output the converted value from (d).



- Input an INT data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

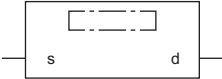
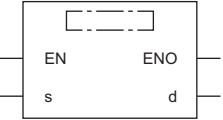
### Operation error

There is no operation error.

# 31.26 Converting INT to TIME

## INT\_TO\_TIME(\_E)

These functions convert a value from INT data type to TIME data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=INT_TO_TIME(s);<br>[With EN/ENO]<br>d:=INT_TO_TIME_E(EN,ENO,s); |
|  |  |                                                                                        |

### Setting data

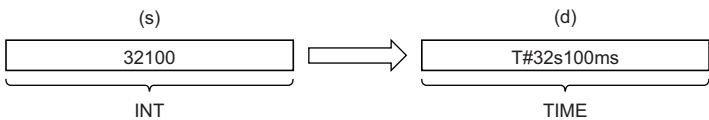
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | TIME      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from INT data type to TIME data type, and output the converted value from (d).



- Input an INT data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

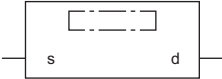
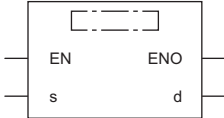
### Operation error

There is no operation error.

# 31.27 Converting INT to STRING

## INT\_TO\_STRING(\_E)

These functions convert a value from INT data type to STRING data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=INT_TO_STRING(s);<br/>[With EN/ENO]<br/>d:=INT_TO_STRING_E(EN,ENO,s);</div> |
|  |  |                                                                                                          |

### Setting data

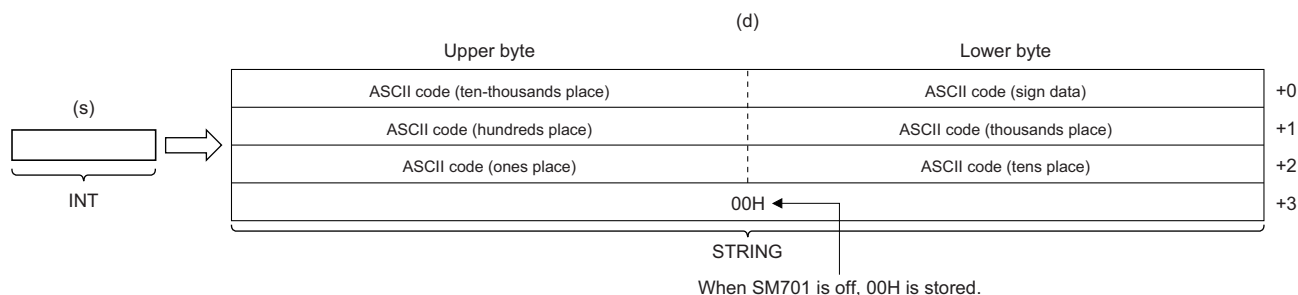
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | STRING(6) |

## Processing details

### ■Operation processing

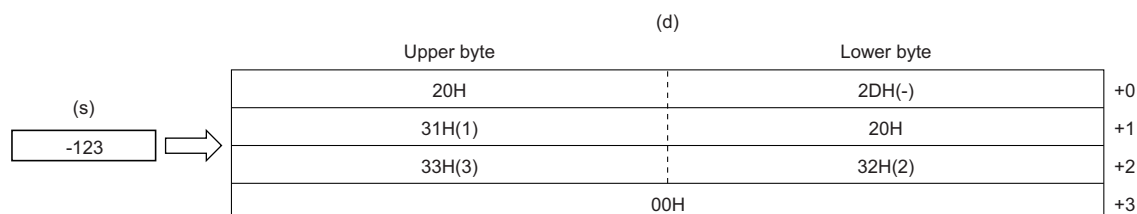
- These functions convert the value input to (s) from INT data type to STRING data type, and output the converted value from (d).



- Input an INT data type value to (s).
- As sign data, 20H (space) is stored if the input value is positive, and 2DH (-) is stored if the value is negative.
- If the number of digits in the input value is less than the number of significant digits, 20H (space) is stored for the upper digit(s).

### Ex.

When the value -123 is input



- When SM701 (Number of output characters selection) is off, 00H is stored at the end of the string (4th word).

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

There is no operation error.

# 31.28 Converting DINT to BOOL

31

## DINT\_TO\_BOOL(\_E)

These functions convert a value from DINT data type to BOOL data type.

| Ladder, FBD/LD   |               | ST                                                                                       |
|------------------|---------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>d:=DINT_TO_BOOL(s);<br>[With EN/ENO]<br>d:=DINT_TO_BOOL_E(EN,ENO,s); |

### Setting data

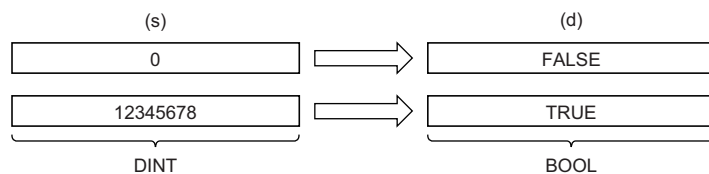
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DINT      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | BOOL      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from DINT data type to BOOL data type, and output the converted value from (d).
- When the value 0 is input, FALSE is output.
- When the value other than 0 is input, TRUE is output.



- Input a DINT data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

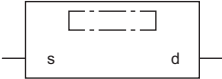
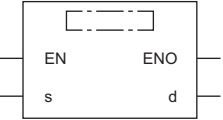
### Operation error

There is no operation error.

# 31.29 Converting DINT to WORD

## DINT\_TO\_WORD(\_E)

These functions convert a value from DINT data type to WORD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DINT_TO_WORD(s);<br>[With EN/ENO]<br>d:=DINT_TO_WORD_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

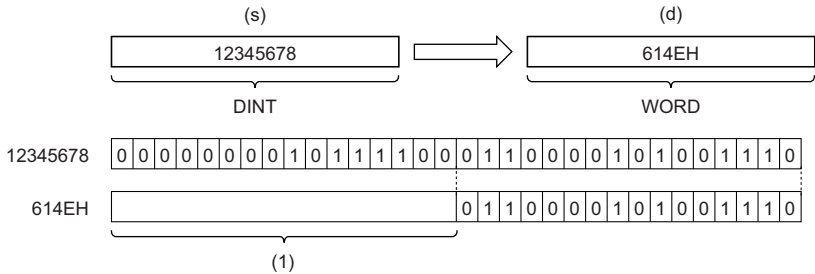
#### Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DINT      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | WORD      |

### Processing details

#### Operation processing

- These functions convert the value input to (s) from DINT data type to WORD data type, and output the converted value from (d).
- The upper 16-bit data of the input value (DINT data type) are discarded. (Refer to (1) in the figure below.)



- Input a DINT data type value to (s).

#### Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

#### Point

When the DINT\_TO\_WORD(\_E) function is executed, the upper 16-bit data of the input value (DINT data type) are discarded.



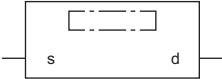
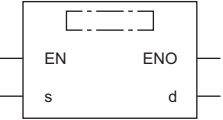
## Operation error

There is no operation error.

# 31.30 Converting DINT to DWORD

## DINT\_TO\_DWORD(\_E)

These functions convert a value from DINT data type to DWORD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DINT_TO_DWORD(s);<br>[With EN/ENO]<br>d:=DINT_TO_DWORD_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

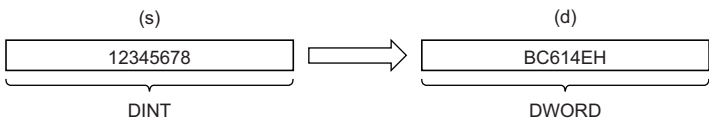
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DINT      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DWORD     |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from DINT data type to DWORD data type, and output the converted value from (d).



- Input a DINT data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

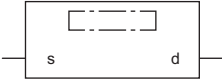
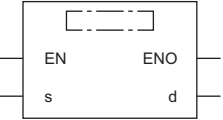
### Operation error

There is no operation error.

# 31.31 Converting DINT to INT

## DINT\_TO\_INT(\_E)

These functions convert a value from DINT data type to INT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DINT_TO_INT(s);<br>[With EN/ENO]<br>d:=DINT_TO_INT_E(EN,ENO,s); |
|  |  |                                                                                        |

### Setting data

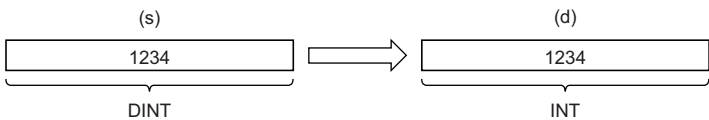
#### Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DINT      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | INT       |

### Processing details

#### Operation processing

- These functions convert the value input to (s) from DINT data type to INT data type, and output the converted value from (d).



- Input a DINT data type value to (s).

#### Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

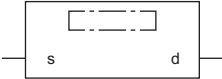
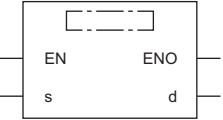
### Operation error

| Error code (SD0) | Description                                                                      |
|------------------|----------------------------------------------------------------------------------|
| 3281H            | The 32-bit signed binary data input to (s) is out of the range, -32768 to 32767. |

# 31.32 Converting DINT to BCD

## DINT\_TO\_BCD(\_E)

These functions convert a value from DINT data type to BCD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DINT_TO_BCD(s);<br>[With EN/ENO]<br>d:=DINT_TO_BCD_E(EN,ENO,s); |
|  |  |                                                                                        |

### Setting data

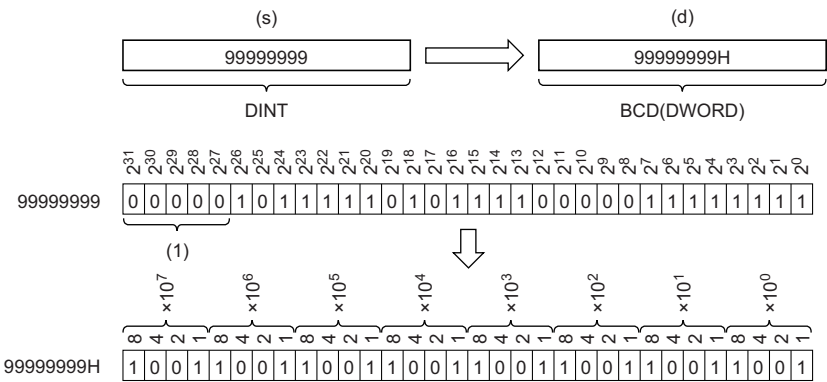
#### Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DINT      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_BIT   |

### Processing details

#### Operation processing

- These functions convert the value input to (s) from DINT data type to BCD (DWORD) data type, and output the converted value from (d).



(1) Make sure to set them to "0".

- Input a DINT data type value to (s). When (d) is of WORD data type, the input value range is 0 to 9999. When (d) is of DWORD data type, the input value range is 0 to 99999999.
- WORD or DWORD data type can be specified for (d). BOOL data type cannot be specified.

## ■ Operation result

### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

- When (d) is of WORD data type

| Error code (SD0) | Description                                                                      |
|------------------|----------------------------------------------------------------------------------|
| 3281H            | The 32-bit signed binary data input to (s) is out of the range, -32768 to 32767. |
|                  | Data input to (s) is out of the range, 0 to 9999.                                |

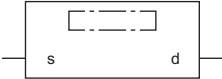
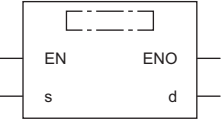
- When (d) is of DWORD data type

| Error code (SD0) | Description                                                             |
|------------------|-------------------------------------------------------------------------|
| 3281H            | Data in the device specified by (s) is out of the range, 0 to 99999999. |

# 31.33 Converting DINT to REAL

## DINT\_TO\_REAL(\_E)

These functions convert a value from DINT data type to REAL data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DINT_TO_REAL(s);<br>[With EN/ENO]<br>d:=DINT_TO_REAL_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

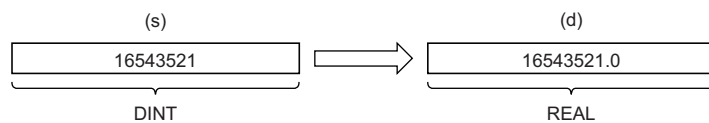
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DINT      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | REAL      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from DINT data type to REAL data type, and output the converted value from (d).



- Input a DINT data type value to (s).
- The number of significant digits is about seven because a REAL data type value is processed in 32-bit single precision.
- If the integer value exceeds the range of -16777216 to 16777215, a rounding error occurs in the converted value.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

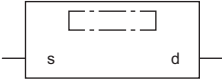
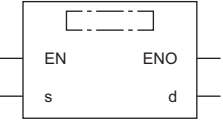
There is no operation error.

# 31.34 Converting DINT to LREAL

31

## DINT\_TO\_LREAL(\_E)

These functions convert a value from DINT data type to LREAL data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DINT_TO_LREAL(s);<br>[With EN/ENO]<br>d:=DINT_TO_LREAL_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

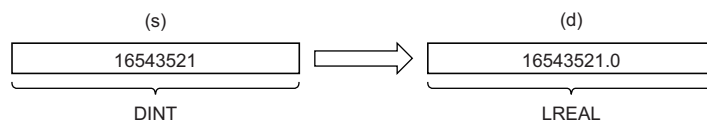
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DINT      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | LREAL     |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from DINT data type to LREAL data type, and output the converted value from (d).



- Input a DINT data type value to (s).
- The number of significant digits is about 15 because an LREAL data type value is processed in 64-bit double precision.
- If the integer value exceeds the range of -2147483648 to 2147483647, a rounding error occurs in the converted value.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

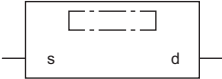
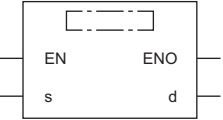
### Operation error

There is no operation error.

# 31.35 Converting DINT to TIME

## DINT\_TO\_TIME(\_E)

These functions convert a value from DINT data type to TIME data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DINT_TO_TIME(s);<br>[With EN/ENO]<br>d:=DINT_TO_TIME_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

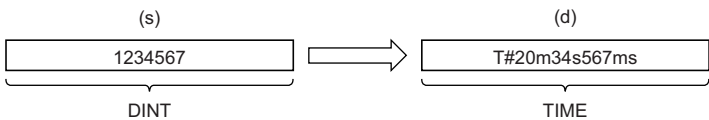
#### Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | DINT      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | TIME      |

### Processing details

#### Operation processing

- These functions convert the value input to (s) from DINT data type to TIME data type, and output the converted value from (d).



- Input a DINT data type value to (s).

#### Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

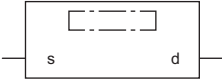
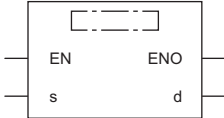
There is no operation error.



# 31.36 Converting DINT to STRING

## DINT\_TO\_STRING(\_E)

These functions convert a value from DINT data type to STRING data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=DINT_TO_STRING(s);<br/>[With EN/ENO]<br/>d:=DINT_TO_STRING_E(EN,ENO,s);</div> |
|  |  |                                                                                                            |

### Setting data

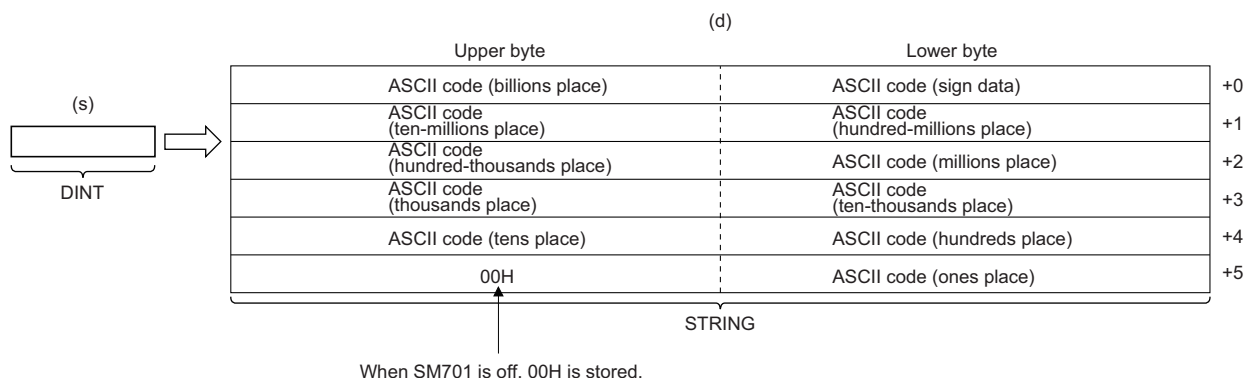
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type  |
|----------|-----------------------------------------------------------|-----------------|------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL       |
| s (IN)   | Input                                                     | Input variable  | DINT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL       |
| d        | Output                                                    | Output variable | STRING(11) |

## Processing details

### ■Operation processing

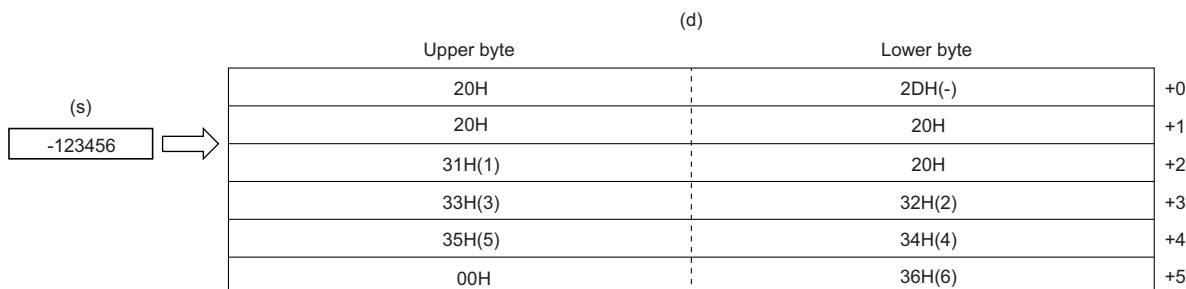
- These functions convert the value input to (s) from DINT data type to STRING data type, and output the converted value from (d).



- Input a DINT data type value to (s).
- As sign data, 20H (space) is stored if the input value is positive, and 2DH (-) is stored if the value is negative.
- If the number of digits in the input value is less than the number of significant digits, 20H (space) is stored for the upper digit(s).

#### Ex.

When the value -123456 is input



- When SM701 (Number of output characters selection) is off, 00H is stored at the end of the string (upper bytes of the 6th word).

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

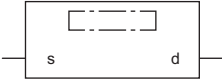
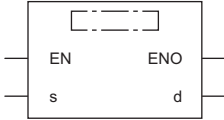
## Operation error

There is no operation error.

# 31.37 Converting BCD to INT

## BCD\_TO\_INT(\_E)

These functions convert a value from BCD data type to INT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                 |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=BCD_TO_INT(s);<br/>[With EN/ENO]<br/>d:=BCD_TO_INT_E(EN,ENO,s);</div> |
|  |  |                                                                                                    |

### Setting data

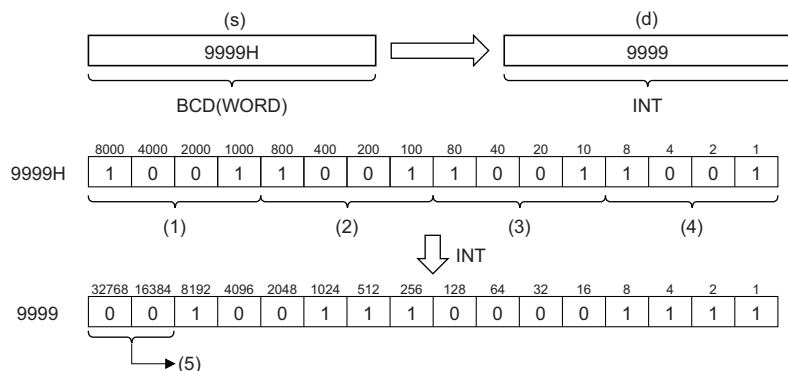
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | WORD      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | INT       |

## Processing details

### ■Operation processing

- These functions convert the value input to (s) from BCD (WORD) data type to INT data type, and output the converted value from (d).



- (1) Thousands place
- (2) Hundreds place
- (3) Tens place
- (4) Ones place
- (5) Always becomes "0".

- Input a WORD data type value to (s) within the range of 0H to 9999H (range of each digit: 0 to 9).

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

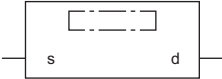
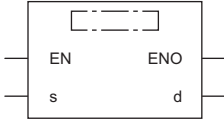
| Error code (SD0) | Description                                                              |
|------------------|--------------------------------------------------------------------------|
| 3281H            | A value other than 0 to 9 exists at any digit of the value input to (s). |

Turning on SM754 can prevent the above error from being issued. If the specified value is out of the valid range, the BCD\_TO\_INT(\_E) function is not executed regardless of the status (on/off) of SM754.

# 31.38 Converting BCD to DINT

## BCD\_TO\_DINT(\_E)

These functions convert a value from BCD data type to DINT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=BCD_TO_DINT(s);<br>[With EN/ENO]<br>d:=BCD_TO_DINT_E(EN,ENO,s); |
|  |  |                                                                                        |

### Setting data

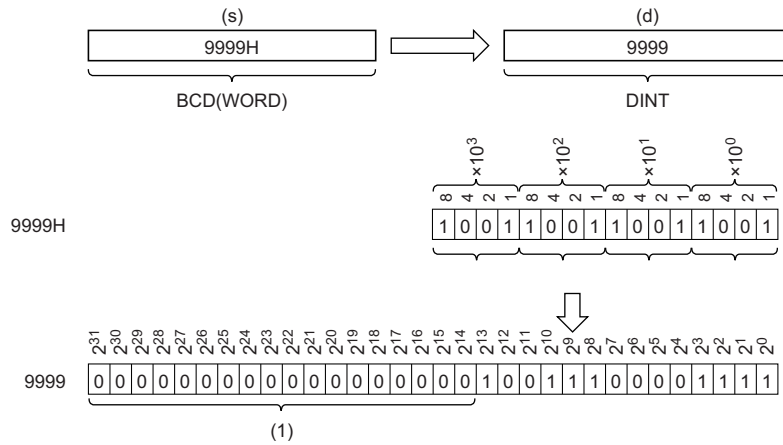
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_BIT   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DINT      |

## Processing details

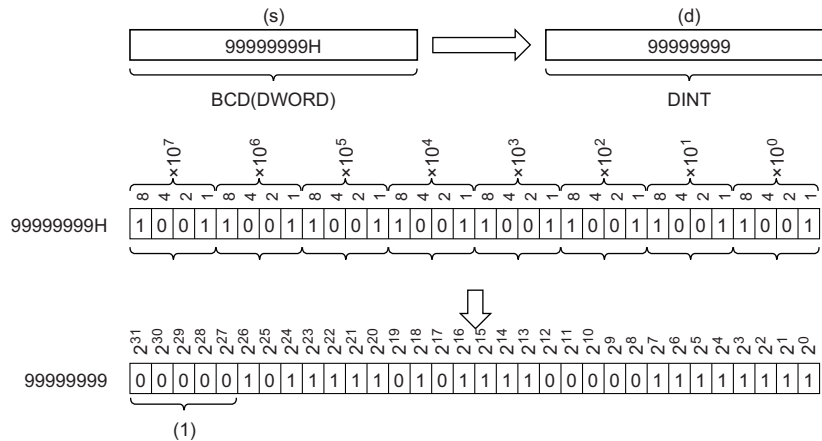
### ■Operation processing

- These functions convert the value input to (s) from BCD (WORD or DWORD) data type to DINT data type, and output the converted value from (d).
- When (s) is of WORD data type



(1) Always becomes "0".

- When (s) is of DWORD data type



(1) Always becomes "0".

- Input a WORD data type value within the range of 0H to 9999H (range of each digit: 0 to 9) or a DWORD data type value within the range of 0H to 99999999H (range of each digit: 0 to 9) to (s).
- WORD or DWORD data type can be specified for (s). BOOL data type cannot be specified.

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

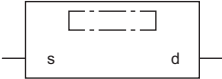
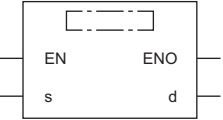
| Error code (SD0) | Description                                                              |
|------------------|--------------------------------------------------------------------------|
| 3281H            | A value other than 0 to 9 exists at any digit of the value input to (s). |

Turning on SM754 can prevent the above error from being issued. If the specified value is out of the valid range, the BCD\_TO\_DINT(\_E) function is not executed regardless of the status (on/off) of SM754.

# 31.39 Converting BCD to STRING

## BCD\_TO\_STRING(\_E)

These functions convert a value from BCD data type to STRING data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=BCD_TO_STRING(s);<br>[With EN/ENO]<br>d:=BCD_TO_STRING_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

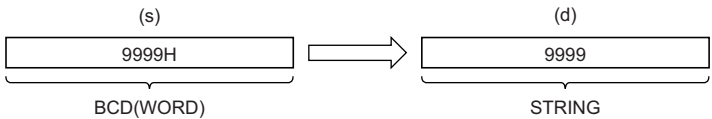
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_BIT   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | STRING(8) |

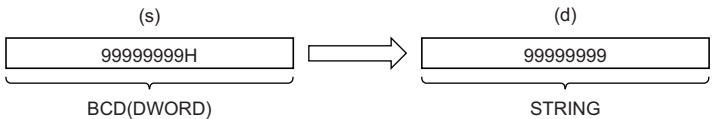
### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from BCD (WORD or DWORD) data type to STRING data type, and output the converted value from (d).
- When (s) is of WORD data type



- When (s) is of DWORD data type



- WORD or DWORD data type can be specified for (s). BOOL data type cannot be specified.
- When SM701 (Number of output characters selection) is off, 00H is stored at the end of the string.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  |                     | Operation result              |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.



## Operation error

- When (s) is of WORD data type

| Error code (SD0) | Description                                       |
|------------------|---------------------------------------------------|
| 3281H            | Data input to (s) is out of the range, 0 to 9999. |

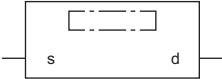
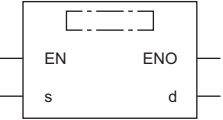
- When (s) is of DWORD data type

| Error code (SD0) | Description                                                             |
|------------------|-------------------------------------------------------------------------|
| 3281H            | Data in the device specified by (s) is out of the range, 0 to 99999999. |

# 31.40 Converting REAL to INT

## REAL\_TO\_INT(\_E)

These functions convert a value from REAL data type to INT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=REAL_TO_INT(s);<br>[With EN/ENO]<br>d:=REAL_TO_INT_E(EN,ENO,s); |
|  |  |                                                                                        |

### Setting data

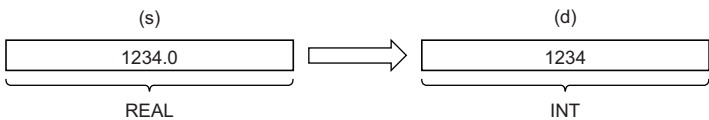
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | REAL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | INT       |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from REAL data type to INT data type, and output the converted value from (d).



- Input a REAL data type value to (s) within the range of -32768 to 32767.
- After conversion, the first digit after the decimal point of the input value (REAL data type) is rounded off.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

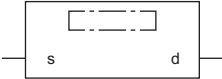
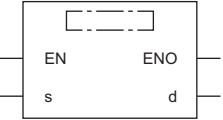
\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The single-precision real number input to (s) is out of the range, -32768 to 32767.                                                                                                                                                                                                                                                                                                                                                                                                           |
| 3282H            | <ul style="list-style-type: none"> <li>An unusual number is set to (s).</li> <li>The single-precision real number input to (s) is not within the following range:<br/> <math>-2^{128} &lt; (s) \leq -2^{126}</math>, 0, <math>2^{-126} \leq (s) &lt; 2^{128}</math><br/>           (E-3.40282347+38 to E-1.17549435-38, 0, E1.17549435-38 to E3.40282347+38)</li> <li>The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

# 31.41 Converting REAL to DINT

## REAL\_TO\_DINT(\_E)

These functions convert a value from REAL data type to DINT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=REAL_TO_DINT(s);<br>[With EN/ENO]<br>d:=REAL_TO_DINT_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

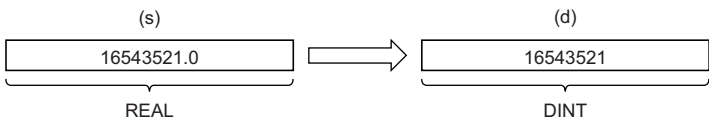
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | REAL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DINT      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from REAL data type to DINT data type, and output the converted value from (d).



- Input a REAL data type value to (s) within the range of -2147483648 to 2147483647.
- After conversion, the first digit after the decimal point of the input value (REAL data type) is rounded off.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

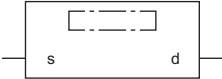
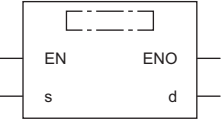
\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The single-precision real number input to (s) is out of the range, -2147483648 to 2147483647.                                                                                                                                                                                                                                                                                                                                                                                                  |
| 3282H            | <ul style="list-style-type: none"> <li>An unusual number is set to (s).</li> <li>The single-precision real number input to (s) is not within the following range:<br/> <math>-2^{128} &lt; (s) \leq -2^{-126}</math>, 0, <math>2^{-126} \leq (s) &lt; 2^{128}</math><br/>           (E-3.40282347+38 to E-1.17549435-38, 0, E1.17549435-38 to E3.40282347+38)</li> <li>The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

# 31.42 Converting REAL to LREAL

## REAL\_TO\_LREAL(\_E)

These functions convert a value from REAL data type to LREAL data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=REAL_TO_LREAL(s);<br>[With EN/ENO]<br>d:=REAL_TO_LREAL_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

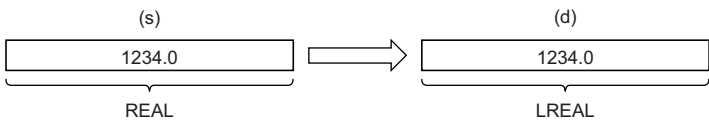
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | REAL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | LREAL     |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from REAL data type to LREAL data type, and output the converted value from (d).



- Input a REAL data type value to (s).
- The number of significant digits is about seven because a REAL data type value is processed in 32-bit single precision.
- If the integer value exceeds the range of -16777216 to 16777215, a rounding error occurs in the converted value.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

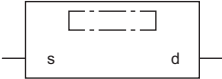
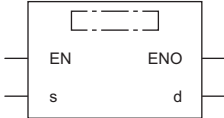
\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

| Error code<br>(SD0) | Description                                                                                                                                                                                                   |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H               | The data input to (s) is -0 or out of the following range.<br>$-2^{128} < (s) \leq -2^{-126}$ , 0, $2^{-126} \leq (s) < 2^{128}$<br>(E-3.40282347+38 to E-1.17549435-38, 0, E1.17549435-38 to E3.40282347+38) |

# 31.43 Converting REAL to STRING

## REAL\_TO\_STRING(\_E)

These functions converts a REAL data type value to STRING data type (exponential form).

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                                |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=REAL_TO_STRING(s);</div> <div>[With EN/ENO]<br/>d:=REAL_TO_STRING_E(EN,ENO,s);</div> |
|  |  |                                                                                                                   |

### Setting data

#### ■Description, type, data type

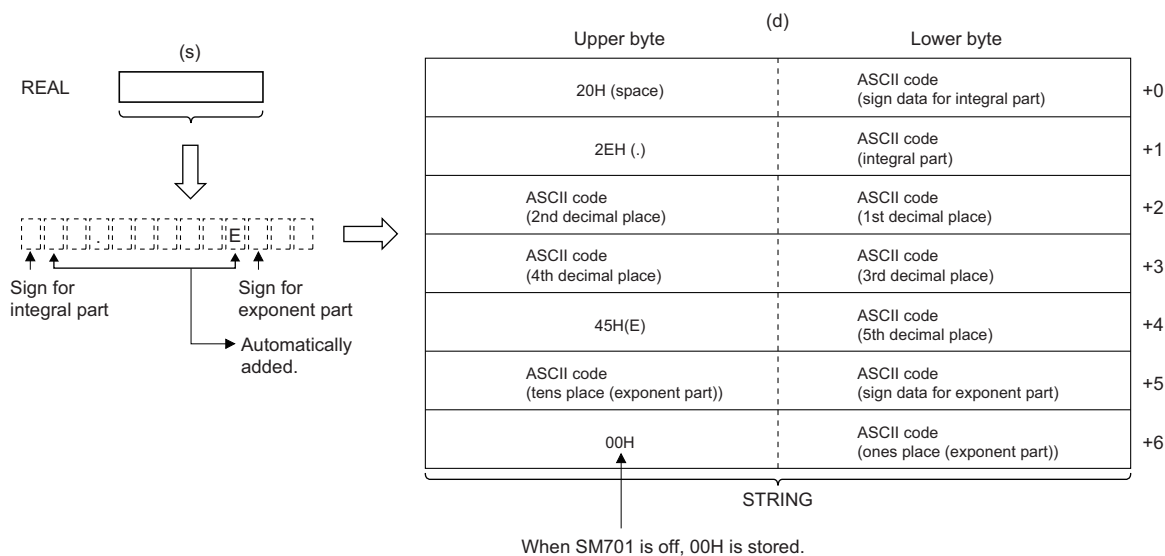
| Argument | Description                                               | Type            | Data type  |
|----------|-----------------------------------------------------------|-----------------|------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL       |
| s (IN)   | Input                                                     | Input variable  | REAL       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL       |
| d        | Output                                                    | Output variable | STRING(13) |



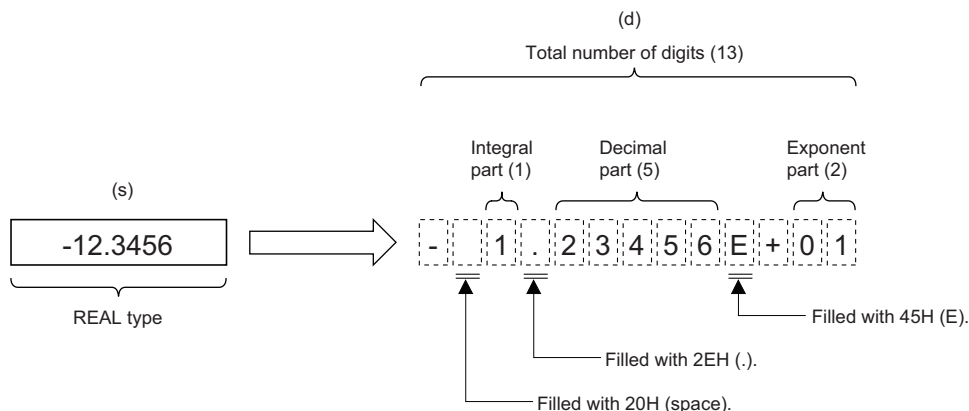
## Processing details

### ■Operation processing

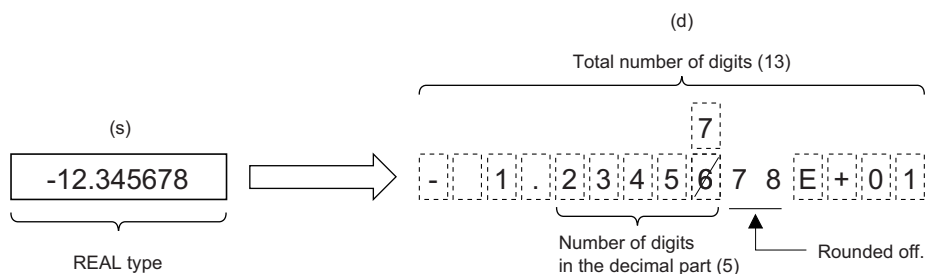
- These functions convert the value input to (s) from REAL data type to STRING data type (exponential form), and output the converted value from (d).



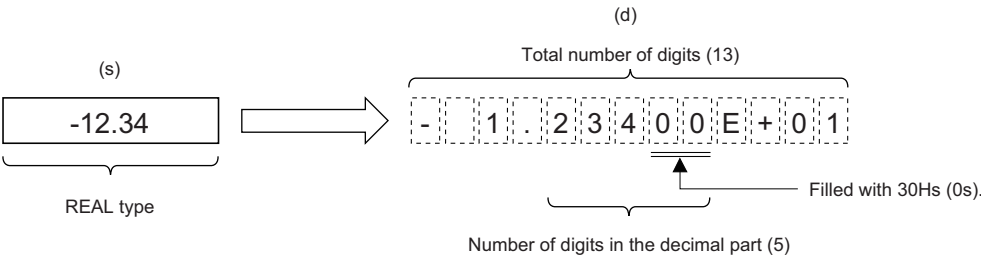
- Input a REAL data type value to (s).
- The converted string data is output from (d) as follows.
  - The number of digits for an integral part, decimal part, and exponent is fixed, integral part: one digit; decimal part: five digits; exponent: two digits.
  - As the second byte, 20H (space) is stored; as the fourth byte, 2EH (.) is stored; and as the 10th byte, 45H (E) is stored automatically.



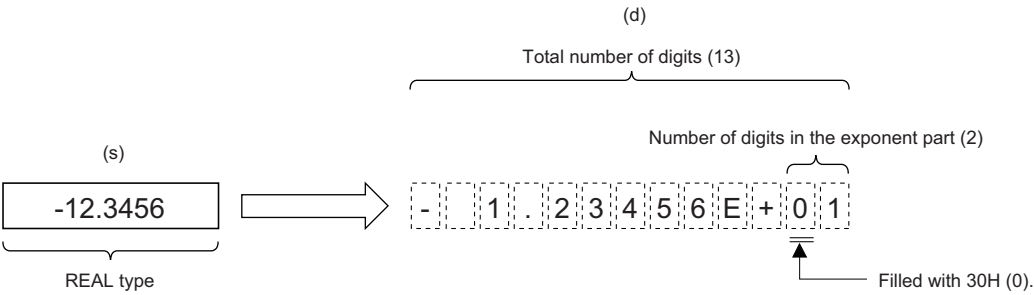
- As sign data (for integral part), 20H (space) is stored if the input value is positive, and 2DH (-) is stored if the input value is negative.
- The sixth and later digits of the decimal part are rounded off.



- If the number of digits in the input value is less than the number of significant digits, 30H (0) is stored in the decimal part.



- As sign data (for exponent), 2BH (+) is stored if the input value is positive, and 2DH (-) is stored if the input value is negative.
- When the exponent is one digit, 30H (0) is stored in the tens place of the exponent.



- The NULL code (00H) is automatically stored at the end (i.e. seventh word) of the converted string.

■Operation result

1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

Operation error

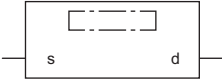
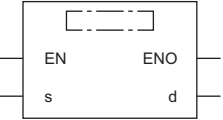
| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | <ul style="list-style-type: none"><li>• The value input to (s) is out of the following range:<br/><math>-2^{128} &lt; (s) \leq -2^{126}</math>, <math>0</math>, <math>2^{-126} \leq (s) &lt; 2^{128}</math><br/>(E-3.40282347+38 to E-1.17549435-38, <math>0</math>, E1.17549435-38 to E3.40282347+38)</li><li>• The value input to (s) is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li></ul> |
| 3286H            | The entire string after conversion cannot be stored in the label or device area (between the specified device number and the last device number) specified by (d). (The number of required points is insufficient.)                                                                                                                                                                                                         |

# 31.44 Converting LREAL to INT

31

## LREAL\_TO\_INT(\_E)

These functions convert a value from LREAL data type to INT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=LREAL_TO_INT(s);<br>[With EN/ENO]<br>d:=LREAL_TO_INT_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

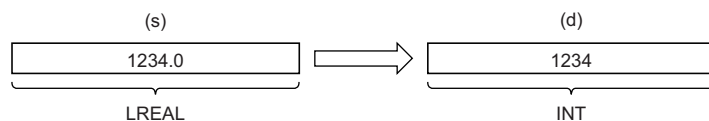
#### Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | LREAL     |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | INT       |

### Processing details

#### Operation processing

- These functions convert the value input to (s) from LREAL data type to INT data type, and output the converted value from (d).



- Input an LREAL data type value to (s).
- After conversion, the first digit after the decimal point of the input value (LREAL data type) is rounded off.

#### Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

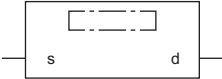
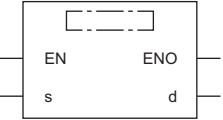
### Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The data input to (s) is outside the range of -32768 to 32767.                                                                                                                                                                                                                                                                                                                                                                                                    |
| 3282H            | <ul style="list-style-type: none"> <li>The data input to (s) is -0 or out of the following range.<br/> <math>-2^{1024} &lt; (s), (d) \leq -2^{1022}, 0, 2^{1022} \leq (s), (d) &lt; 2^{1024}</math><br/>           (E-1.7976931348623157+308 to E-2.2250738585072014-308, 0, E2.2250738585072014-308 to E1.7976931348623157+308)</li> <li>The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

# 31.45 Converting LREAL to DINT

## LREAL\_TO\_DINT(\_E)

These functions convert a value from LREAL data type to DINT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=LREAL_TO_DINT(s);<br>[With EN/ENO]<br>d:=LREAL_TO_DINT_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

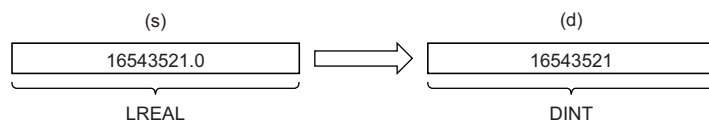
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | LREAL     |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DINT      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from LREAL data type to DINT data type, and output the converted value from (d).



- Input an LREAL data type value to (s).
- After conversion, the first digit after the decimal point of the input value (LREAL data type) is rounded off.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

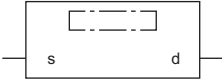
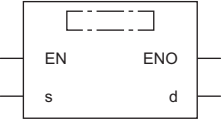
| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | The data input to (s) is outside the range of -32768 to 32767.                                                                                                                                                                                                                                                                                                                                                                                                    |
| 3282H            | <ul style="list-style-type: none"> <li>The data input to (s) is -0 or out of the following range.<br/> <math>-2^{1024} &lt; (s), (d) \leq -2^{1022}, 0, 2^{1022} \leq (s), (d) &lt; 2^{1024}</math><br/>           (E-1.7976931348623157+308 to E-2.2250738585072014-308, 0, E2.2250738585072014-308 to E1.7976931348623157+308)</li> <li>The value set to a device or label is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</li> </ul> |

# 31.46 Converting LREAL to REAL

31

## LREAL\_TO\_REAL(\_E)

These functions convert a value from LREAL data type to REAL data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=LREAL_TO_REAL(s);<br>[With EN/ENO]<br>d:=LREAL_TO_REAL_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

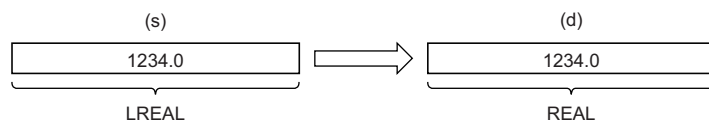
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | LREAL     |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | REAL      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from LREAL data type to REAL data type, and output the converted value from (d).



- Input an LREAL data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

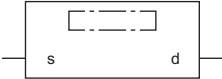
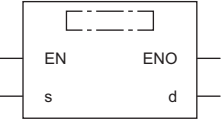
### Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The data input to (s) is -0 or out of the following range.<br>$-2^{1024} < (s)$ , $(d) \leq -2^{1022}$ , $0$ , $2^{1022} \leq (s)$ , $(d) < 2^{1024}$<br>(E-1.7976931348623157+308 to E-2.2250738585072014-308, 0, E2.2250738585072014-308 to E1.7976931348623157+308) |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (d)  < 2^{128}$                                                                                                                                                                 |

# 31.47 Converting TIME to BOOL

## TIME\_TO\_BOOL(\_E)

These functions convert a value from TIME data type to BOOL data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=TIME_TO_BOOL(s);<br>[With EN/ENO]<br>d:=TIME_TO_BOOL_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

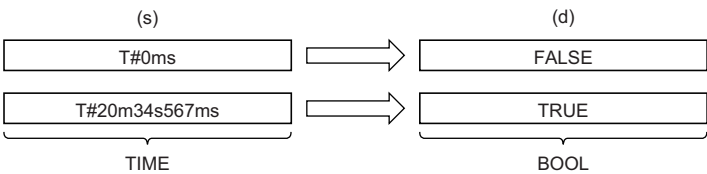
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | TIME      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | BOOL      |

### Processing details

#### ■Operation processing

These functions convert the value input to (s) from TIME data type to BOOL data type, and output the converted value from (d).



#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  |  | Operation result    |                               |
|----------------------|--|---------------------|-------------------------------|
| EN                   |  | ENO                 | (d)                           |
| TRUE (executed)      |  | TRUE                | Operation result output value |
| FALSE (not executed) |  | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

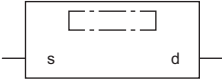
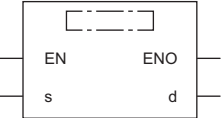
### Operation error

There is no operation error.

# 31.48 Converting TIME to WORD

## TIME\_TO\_WORD(\_E)

These functions convert a value from TIME data type to WORD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=TIME_TO_WORD(s);<br>[With EN/ENO]<br>d:=TIME_TO_WORD_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

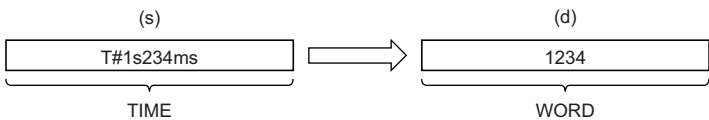
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | TIME      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | WORD      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from TIME data type to WORD data type, and output the converted value from (d).



- Input a TIME data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

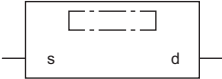
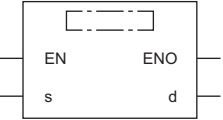
### Operation error

There is no operation error.

# 31.49 Converting TIME to DWORD

## TIME\_TO\_DWORD(\_E)

These functions convert a value from TIME data type to DWORD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=TIME_TO_DWORD(s);<br>[With EN/ENO]<br>d:=TIME_TO_DWORD_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

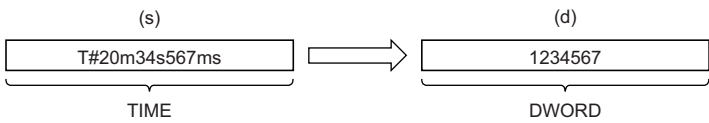
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | TIME      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DWORD     |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from TIME data type to DWORD data type, and output the converted value from (d).



- Input a TIME data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

There is no operation error.

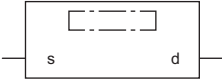
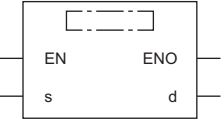


# 31.50 Converting TIME to INT

31

## TIME\_TO\_INT(\_E)

These functions convert a value from TIME data type to INT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=TIME_TO_INT(s);<br>[With EN/ENO]<br>d:=TIME_TO_INT_E(EN,ENO,s); |
|  |  |                                                                                        |

### Setting data

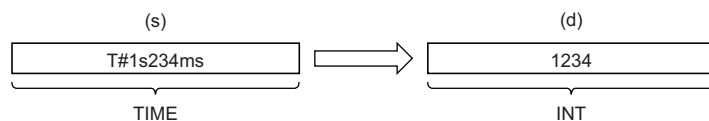
#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s (IN)   | Input                                                           | Input variable  | TIME      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d        | Output                                                          | Output variable | INT       |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from TIME data type to INT data type, and output the converted value from (d).



- Input a TIME data type value to (s).
- The upper 16-bit data of the input value (TIME data type) are discarded.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

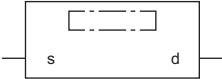
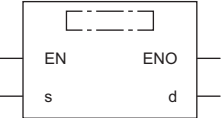
### Operation error

There is no operation error.

# 31.51 Converting TIME to DINT

## TIME\_TO\_DINT(\_E)

These functions convert a value from TIME data type to DINT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=TIME_TO_DINT(s);<br>[With EN/ENO]<br>d:=TIME_TO_DINT_E(EN,ENO,s); |
|  |  |                                                                                          |

### Setting data

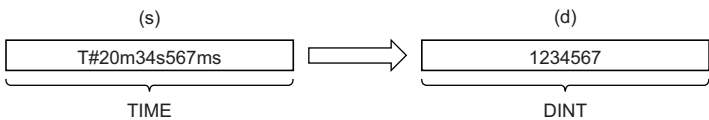
#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s (IN)   | Input                                                           | Input variable  | TIME      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d        | Output                                                          | Output variable | DINT      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from TIME data type to DINT data type, and output the converted value from (d).



- Input a TIME data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

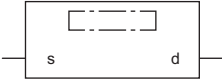
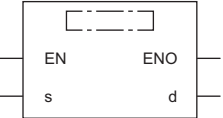
### Operation error

There is no operation error.

# 31.52 Converting TIME to STRING

## TIME\_TO\_STRING(\_E)

These functions convert a value from TIME data type to STRING data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                           |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=TIME_TO_STRING(s);<br>[With EN/ENO]<br>d:=TIME_TO_STRING_E(EN,ENO,s); |
|  |  |                                                                                              |

### Setting data

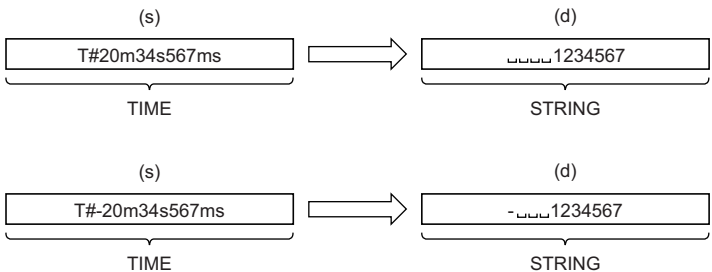
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type            |
|----------|-----------------------------------------------------------|-----------------|----------------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL                 |
| s (IN)   | Input                                                     | Input variable  | TIME                 |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL                 |
| d        | Output                                                    | Output variable | STRING<br>STRING(11) |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from TIME data type to STRING data type, and output the converted value from (d).



- Input a TIME data type value to (s).
- When SM701 (Number of output characters selection) is off, 00H is stored at the end of the string.
- The operation result will be as follows.
  - As the first character, 20H (space) is stored if the output value is positive, and 2DH (-) is stored if the output value is negative.
  - At the left of the number of significant digits, 20H (space) is stored.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

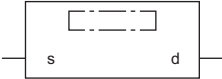
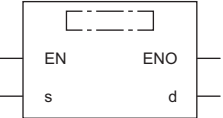
There is no operation error.

# 31.53 Converting STRING to BOOL

31

## STRING\_TO\_BOOL(\_E)

These functions convert a value from STRING data type to BOOL data type.

| Ladder, FBD/LD                                                                                        |                                                                                                    | ST                                                                                           |
|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| [Without EN/ENO]<br> | [With EN/ENO]<br> | [Without EN/ENO]<br>d:=STRING_TO_BOOL(s);<br>[With EN/ENO]<br>d:=STRING_TO_BOOL_E(EN,ENO,s); |

### Setting data

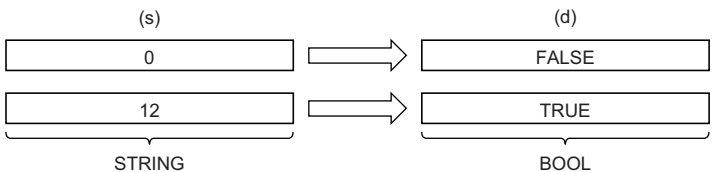
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | STRING(1) |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | BOOL      |

### Processing details

#### ■Operation processing

These functions convert the value input to (s) from STRING data type (decimal form/exponential form) to BOOL data type, and output the converted value from (d).



#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

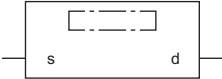
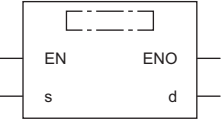
### Operation error

There is no operation error.

# 31.54 Converting STRING to WORD

## STRING\_TO\_WORD(\_E)

These functions convert a value from STRING data type to WORD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                           |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=STRING_TO_WORD(s);<br>[With EN/ENO]<br>d:=STRING_TO_WORD_E(EN,ENO,s); |
|  |  |                                                                                              |

### Setting data

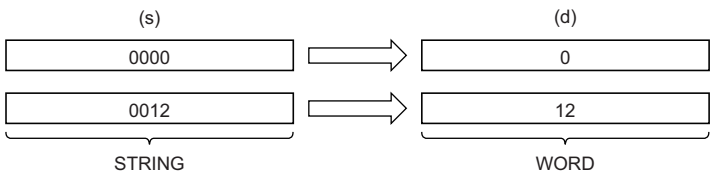
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | STRING(4) |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | WORD      |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from STRING data type to WORD data type, and output the converted value from (d).



- Input a STRING data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

| Error code (SD0) | Description                                                  |
|------------------|--------------------------------------------------------------|
| 3281H            | An ASCII code other than 30H to 39H and 41H to 46H is input. |

# 31.55 Converting STRING to DWORD

31

## STRING\_TO\_DWORD(\_E)

These functions convert a value from STRING data type to DWORD data type.

| Ladder, FBD/LD   |               | ST                                                                                             |
|------------------|---------------|------------------------------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>d:=STRING_TO_DWORD(s);<br>[With EN/ENO]<br>d:=STRING_TO_DWORD_E(EN,ENO,s); |

### Setting data

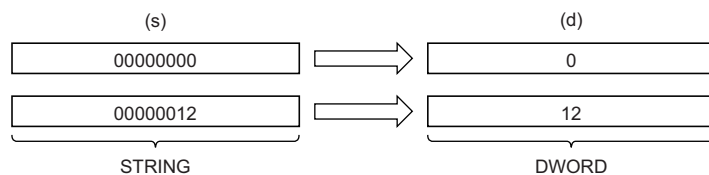
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | STRING(8) |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | DWORD     |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from STRING data type to DWORD data type, and output the converted value from (d).



- Input a STRING data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

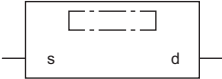
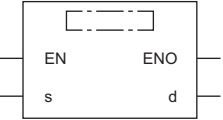
### Operation error

| Error code (SD0) | Description                                                  |
|------------------|--------------------------------------------------------------|
| 3281H            | An ASCII code other than 30H to 39H and 41H to 46H is input. |

# 31.56 Converting STRING to INT

## STRING\_TO\_INT(\_E)

These functions convert a value from STRING data type to INT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=STRING_TO_INT(s);<br>[With EN/ENO]<br>d:=STRING_TO_INT_E(EN,ENO,s); |
|  |  |                                                                                            |

### Setting data

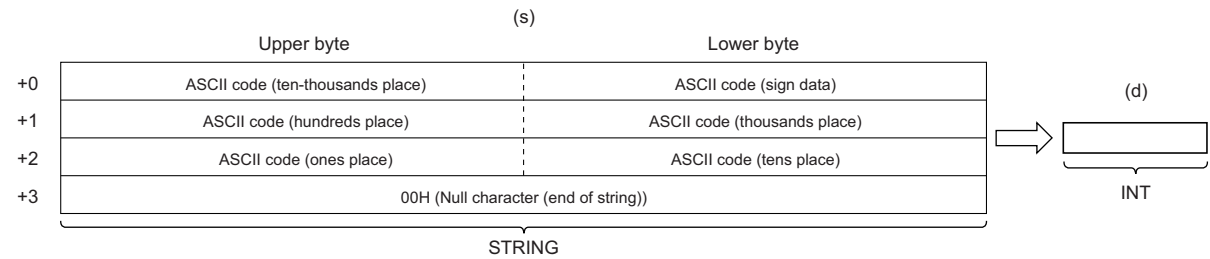
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | STRING(6) |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | INT       |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from STRING data type to INT data type, and output the converted value from (d).



- Input a STRING data type value to (s) within the following range.
  - ASCII code: 30H to 39H, 20H, 2DH, and 00H
  - STRING data type value: -32768 to 32767

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

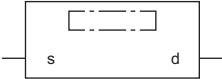
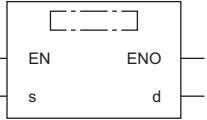


| Error code (SD0) | Description                                                                                                                                                                                                               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | Invalid data that cannot be converted are input in (s). <ul style="list-style-type: none"> <li>• ASCII code: other than 30H to 39H, 20H, and 00H</li> <li>• STRING data type value: other than -32768 to 32767</li> </ul> |

# 31.57 Converting STRING to DINT

## STRING\_TO\_DINT(\_E)

These functions convert a value from STRING data type to DINT data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                           |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=STRING_TO_DINT(s);<br>[With EN/ENO]<br>d:=STRING_TO_DINT_E(EN,ENO,s); |
|  |  |                                                                                              |

### Setting data

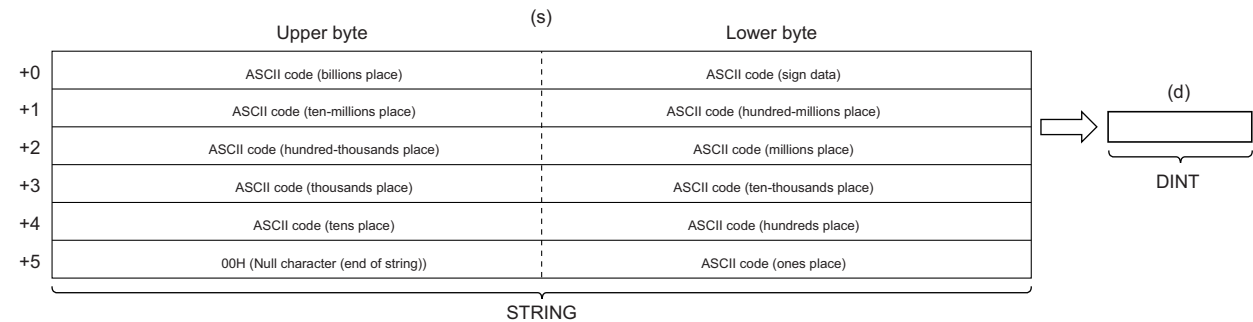
#### Description, type, data type

| Argument | Description                                               | Type            | Data type  |
|----------|-----------------------------------------------------------|-----------------|------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL       |
| s (IN)   | Input                                                     | Input variable  | STRING(11) |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL       |
| d        | Output                                                    | Output variable | DINT       |

### Processing details

#### Operation processing

- These functions convert the value input to (s) from STRING data type to DINT data type, and output the converted value from (d).



- Input a STRING data type value to (s) within the following range.
- ASCII code: 30H to 39H, 20H, 2DH, and 00H
- STRING data type value: -2147483648 to 2147483647

#### Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

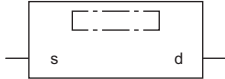
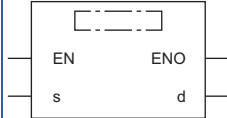
<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

| Error code (SD0) | Description                                                                                                                                                                                                                      |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | Invalid data that cannot be converted are input in (s). <ul style="list-style-type: none"><li>• ASCII code: other than 30H to 39H, 20H, and 00H</li><li>• STRING data type value: other than -2147483648 to 2147483647</li></ul> |

# 31.58 Converting STRING to BCD

## STRING\_TO\_BCD(\_E)

These functions convert a value from STRING data type to BCD data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=STRING_TO_BCD(s);<br/>[With EN/ENO]<br/>d:=STRING_TO_BCD_E(EN,ENO,s);</div> |
|  |  |                                                                                                          |

### Setting data

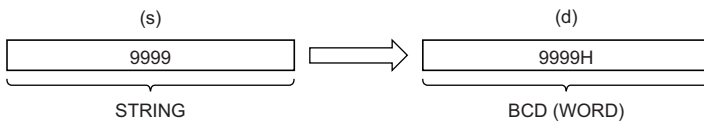
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | STRING(8) |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_BIT   |

## Processing details

### ■Operation processing

- These functions convert the value input to (s) from STRING data type to BCD (WORD) data type, and output the converted value from (d).



- The ASCII code 20H (space) that exists in the string is ignored.
- The ASCII codes 20H (space) and 30H (0) that exist in the string are counted as one character as well.
- Input a STRING data type value to (s) within the following range.  
ASCII code: 30H to 39H, 20H, 00H
- If the string input has less than four characters, the string will be supplemented with zero(s). (Zero(s) is/are added at the end of the string.) For this reason, if a string shorter than four characters is to be converted, input a string padded with 0s (e.g. '0001' for '1').
- If the string length exceeds 4 characters, the four left characters are regarded as the targets to convert.

| Input string | Conversion target string | Output (BCD data type) |
|--------------|--------------------------|------------------------|
| '1'          | '1000'                   | 1000H (4096D)          |
| '12'         | '1200'                   | 1200H (4608D)          |
| '123'        | '1230'                   | 1230H (4656D)          |
| '1234'       | '1234'                   | 1234H (4660D)          |
| '12345'      | '1234'                   | 1234H (4660D)          |

- WORD or DWORD data type can be specified for (d). BOOL data type cannot be specified.

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

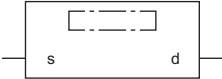
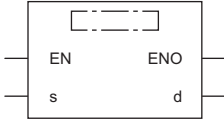
## Operation error

| Error code (SD0) | Description                                                |
|------------------|------------------------------------------------------------|
| 3281H            | An ASCII code other than 30H to 39H, 20H, or 00H is input. |

# 31.59 Converting STRING to REAL

## STRING\_TO\_REAL(\_E)

These functions convert a value from STRING data type to REAL data type.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                                |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=STRING_TO_REAL(s);</div> <div>[With EN/ENO]<br/>d:=STRING_TO_REAL_E(EN,ENO,s);</div> |
|  |  |                                                                                                                   |

### Setting data

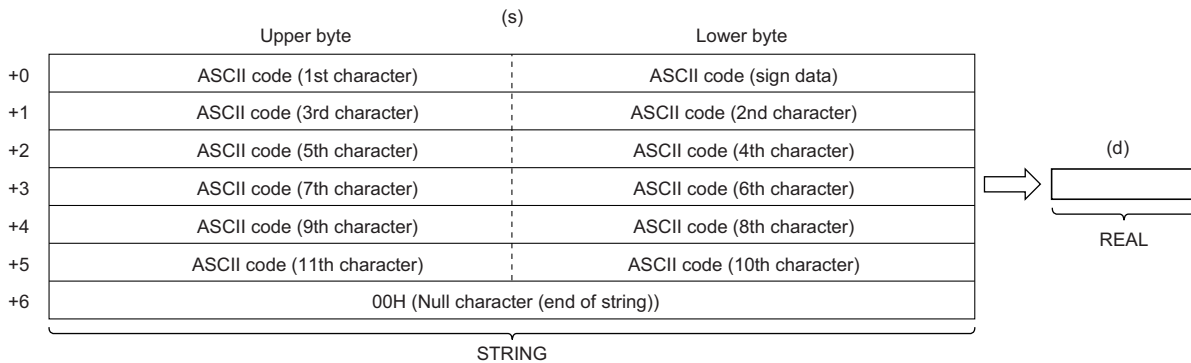
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type  |
|----------|-----------------------------------------------------------|-----------------|------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL       |
| s (IN)   | Input                                                     | Input variable  | STRING(24) |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL       |
| d        | Output                                                    | Output variable | REAL       |

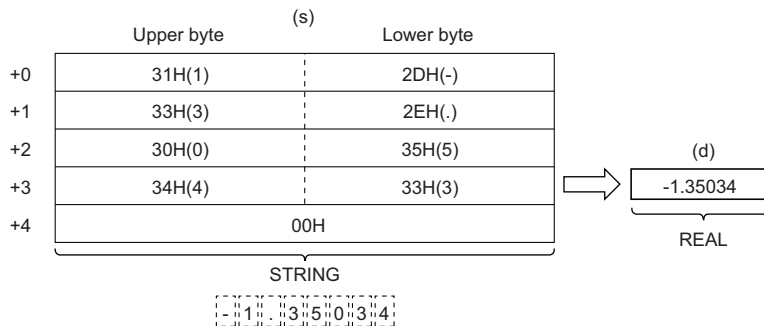
## Processing details

### ■ Operation processing

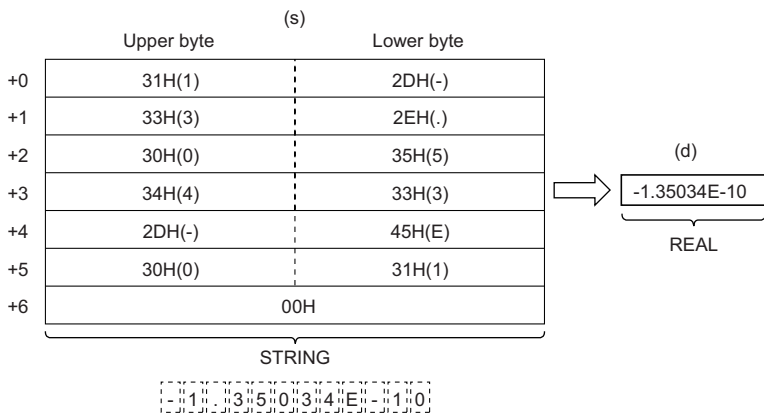
- These functions convert the value input to (s) from STRING data type (decimal form/exponential form) to REAL data type, and output the converted value from (d).



- The STRING data type value both in decimal form and exponential form can be converted.
- When (s) is in decimal form

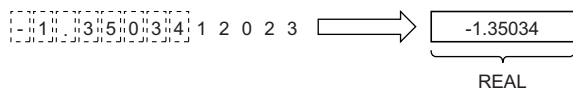


- When (s) is in exponential form

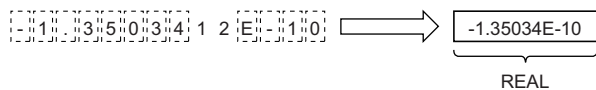


- The number of significant digits of the STRING data type value is six. (The sign, decimal point, and exponent are not included.) The seventh and later digits are rounded down when the data is converted.

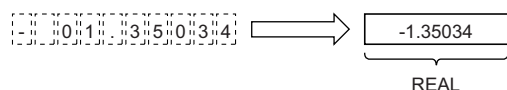
- When (s) is in decimal form



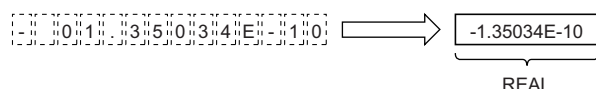
- When (s) is in exponential form



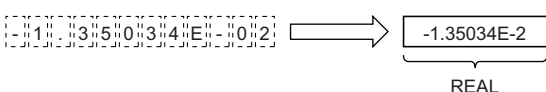
- In decimal form, when 2BH (+) is specified as sign data or the sign data is omitted, the data is converted as a positive value. When 2DH (-) is specified, the data is converted as a negative value.
- In exponential form, when 2BH (+) is specified as sign data for the exponent or the sign data is omitted, the data is converted as a positive value. When 2DH (-) is specified, the data is converted as a negative value.
- The ASCII code 20H (space) or 30H (0) that exists before the first numerical value 0 in the STRING data type value is ignored.
- When (s) is in decimal form



- When (s) is in exponential form



- The ASCII code 30H (0) that exists between E and a numerical value in the STRING data type value is ignored (in exponential form only).



- The ASCII code 20H (space) that exists in the string is ignored.
- Up to 24 characters can be input. The ASCII codes 20H (space) and 30H (0) that exist in the string are counted as one character as well.
- Input a STRING data type value to (s) within the following range.
  - ASCII code: 30H to 39H, 45H, 2BH, 2DH, 2EH, 20H, and 00H

## ■ Operation result

### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the device area (between the specified device number and the last device number) specified by (s).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 3281H            | Invalid data that cannot be converted are set to (s). <ul style="list-style-type: none"> <li>• The integral part or decimal part contains a character other than 30H(0) to 39H(9).</li> <li>• More than one 2EH (.) exists in the specified string.</li> <li>• The exponent of the specified string contains a character other than 45H(E), 65H(e), 2BH(+), and 2DH(-).</li> <li>• The specified string contains more than one exponent 45H(E) or 65H(e).</li> <li>• The exponent in the specified string contains a numerical value consisting of three digits or more.</li> <li>• The exponent of the specified string contains more than one sign 2BH(+) or 2DH(-).</li> <li>• The specified string (in the integral part if the decimal format is used or in the mantissa if the exponent format is used) contains more than one sign data of 2BH(+) or 2DH(-).</li> <li>• The number of characters in the device specified by (s) and later is 0 or exceeds 24.</li> </ul> |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br> (d)  < 2 <sup>128</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |



# 31.60 Converting STRING to TIME

31

## STRING\_TO\_TIME(\_E)

These functions convert a value from STRING data type to TIME data type.

| Ladder, FBD/LD   |               | ST                                                                                           |
|------------------|---------------|----------------------------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>d:=STRING_TO_TIME(s);<br>[With EN/ENO]<br>d:=STRING_TO_TIME_E(EN,ENO,s); |
|                  |               |                                                                                              |

### Setting data

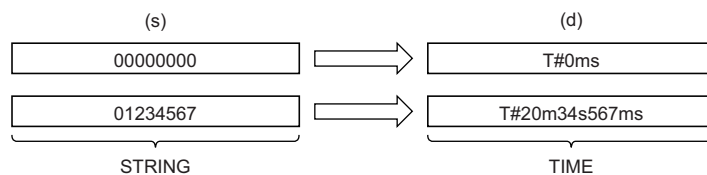
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type  |
|----------|-----------------------------------------------------------|-----------------|------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL       |
| s (IN)   | Input                                                     | Input variable  | STRING(11) |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL       |
| d        | Output                                                    | Output variable | TIME       |

### Processing details

#### ■Operation processing

- These functions convert the value input to (s) from STRING data type to TIME data type, and output the converted value from (d).



- Input a STRING data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

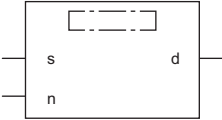
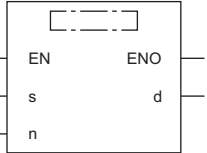
### Operation error

| Error code (SD0) | Description                                                                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3281H            | An ASCII code other than 30H to 39H, 20H, and 00H is input.<br>The STRING data type value input is out of the following range:<br>-2147483648 to 2147483647 |

# 31.61 Converting Bit Array to INT

## BITARR\_TO\_INT(\_E)

These functions convert the specified number of bits in a bit array to an INT data type value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                             |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=BITARR_TO_INT(s,n);<br>[With EN/ENO]<br>d:=BITARR_TO_INT_E(EN,ENO,s,n); |
|  |  |                                                                                                |

### Setting data

#### ■Description, type, data type

| Argument   | Description                                                     | Type            | Data type             |
|------------|-----------------------------------------------------------------|-----------------|-----------------------|
| EN         | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL                  |
| s (BitArr) | Input (An element can be specified by a variable.)              | Input variable  | Boolean array element |
| n          | Number of bits (4, 8, 12, or 16)                                | Input variable  | INT                   |
| ENO        | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL                  |
| d          | Output                                                          | Output variable | ANY16                 |

### Processing details

#### ■Operation processing

- These functions convert the number of bits specified by (n) starting from the bit array element input to (s) to ANY16 type data, and output the converted value from (d).
- Zeros (0s) are set for all the bits exceeding the specified number of bits.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

There is no operation error.

# 31.62 Converting Bit Array to DINT

31

## BITARR\_TO\_DINT(\_E)

These functions convert the specified number of bits in a bit array to a DINT data type value.

| Ladder, FBD/LD   |               | ST                                                                                                                        |
|------------------|---------------|---------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br><code>d:=BITARR_TO_DINT(s,n)</code><br>[With EN/ENO]<br><code>d:=BITARR_TO_DINT_E(EN,ENO,s,n);</code> |

### Setting data

#### ■Description, type, data type

| Argument   | Description                                                     | Type            | Data type             |
|------------|-----------------------------------------------------------------|-----------------|-----------------------|
| EN         | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL                  |
| s (BitArr) | Input (An element can be specified by a variable.)              | Input variable  | Boolean array element |
| n          | Number of bits (4, 8, 12, 16, 20, 24, 28, or 32)                | Input variable  | INT                   |
| ENO        | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL                  |
| d          | Output                                                          | Output variable | ANY32                 |

### Processing details

#### ■Operation processing

- These functions convert the number of bits specified by (n) starting from the bit array element input to (s) to ANY32 type data, and output the converted value from (d).
- Zeros (0s) are set for all the bits exceeding the specified number of bits.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

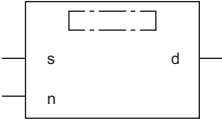
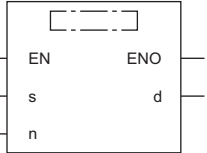
### Operation error

There is no operation error.

# 31.63 Converting INT to Bit Array

## INT\_TO\_BITARR(\_E)

These functions output the lower n bits of the INT data type value to the bit array.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                             |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=INT_TO_BITARR(s,n);<br>[With EN/ENO]<br>d:=INT_TO_BITARR_E(EN,ENO,s,n); |
|  |  |                                                                                                |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type             |
|----------|-----------------------------------------------------------------|-----------------|-----------------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL                  |
| s        | Input                                                           | Input variable  | ANY16                 |
| n        | Number of bits (4, 8, 12, or 16)                                | Input variable  | INT                   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL                  |
| d        | Output (An element can be specified by a variable.)             | Output variable | Boolean array element |

### Processing details

#### ■Operation processing

- These functions output the lower (n) bits of ANY16 type data specified by (s) to (d).
- The output bits beyond the specified number of bits are not changed.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

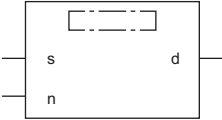
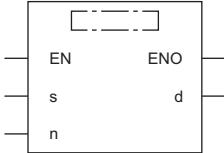
### Operation error

There is no operation error.

# 31.64 Converting DINT to Bit Array

## DINT\_TO\_BITARR(\_E)

These functions output the lower n bits of the DINT data type value to the bit array.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                               |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DINT_TO_BITARR(s,n);<br>[With EN/ENO]<br>d:=DINT_TO_BITARR_E(EN,ENO,s,n); |
|  |  |                                                                                                  |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type             |
|----------|-----------------------------------------------------------------|-----------------|-----------------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL                  |
| s        | Input                                                           | Input variable  | ANY32                 |
| n        | Number of bits (4, 8, 12, 16, 20, 24, 28, or 32)                | Input variable  | BOOL                  |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL                  |
| d        | Output (An element can be specified by a variable.)             | Output variable | Boolean array element |

### Processing details

#### ■Operation processing

- These functions output the lower (n) bits of ANY32 type data specified by (s) to (d).
- The output bits beyond the specified number of bits are not changed.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

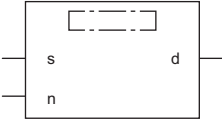
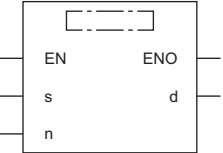
### Operation error

There is no operation error.

# 31.65 Copying the Bit Array

## CPY\_BITARR(\_E)

These functions copy the bit array by the specified number of bits.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=CPY_BITARR(s,n);<br>[With EN/ENO]<br>d:=CPY_BITARR_E(EN,ENO,s,n); |
|  |  |                                                                                          |

### Setting data

#### ■Description, type, data type

| Argument    | Description                                                     | Type            | Data type             |
|-------------|-----------------------------------------------------------------|-----------------|-----------------------|
| EN          | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL                  |
| s(BitArrIn) | Input                                                           | Input variable  | Boolean array element |
| n           | Number of bits (4, 8, 12, 16, 20, 24, 28, or 32)                | Input variable  | INT                   |
| ENO         | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL                  |
| d           | Output                                                          | Output variable | Boolean array element |

### Processing details

#### ■Operation processing

These functions output the bit array (number of (n) bits) specified by (s) to (d).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

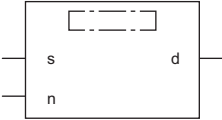
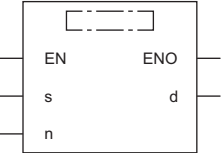
There is no operation error.

# 31.66 Reading the Specified Bit of the Word Label

31

## GET\_BIT\_OF\_INT(\_E)

These functions read a value from the specified bit of a word label.

| Ladder <sup>*1</sup>                                                              |                                                                                   | ST                                                                                               |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=GET_BIT_OF_INT(s,n);<br>[With EN/ENO]<br>d:=GET_BIT_OF_INT_E(EN,ENO,s,n); |
|  |  |                                                                                                  |

\*1 FBD/LD is not supported. For FBD/LD, use the bit specification of labels.

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type         |
|----------|-----------------------------------------------------------------|-----------------|-------------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL              |
| s        | Input                                                           | Input variable  | INT <sup>*1</sup> |
| n        | Number of bits (0 to 15)                                        | Input variable  | INT               |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL              |
| d        | Output                                                          | Output variable | BOOL              |

\*1 Digit-specified labels and devices cannot be used.

### Processing details

#### ■Operation processing

These functions output a value in the (n)th bit of (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

There is no operation error.

By using the bit specification of labels, a concise program having the same operation as GET\_BIT\_OF\_INT can be created.

The following example reads the value in bit 5 (b5) of g\_int1 into g\_bool1 the same as when GET\_BIT\_OF\_INT is used.

Ladder



ST

```
g_bool1 := g_int1.5;
```

FBD/LD

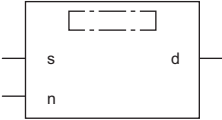
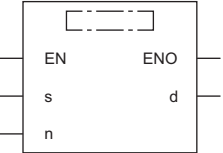




# 31.67 Writing the Specified Bit of the Word Label

## SET\_BIT\_OF\_INT(\_E)

These functions write a value to the specified bit of a word label.

| Ladder <sup>*1</sup>                                                              |                                                                                   | ST                                                                                               |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=SET_BIT_OF_INT(s,n);<br>[With EN/ENO]<br>d:=SET_BIT_OF_INT_E(EN,ENO,s,n); |
|  |  |                                                                                                  |

\*1 FBD/LD is not supported. For FBD/LD, use the bit specification of labels.

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type                  | Data type         |
|----------|-----------------------------------------------------------------|-----------------------|-------------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable        | BOOL              |
| s        | Input                                                           | Input variable        | BOOL              |
| n        | Number of bits (0 to 15)                                        | Input variable        | INT               |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable       | BOOL              |
| d        | Input/output                                                    | Input/output variable | INT <sup>*1</sup> |

\*1 Digit-specified labels and devices cannot be used.

### Processing details

#### ■Operation processing

These functions write a BOOL data type value specified by (s) to the (n)th bit of (d).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Precautions

When using SET\_BIT\_OF\_INT(\_E) in ST, create a program which assigns the return value to a variable.

//The return value of SET\_BIT\_OF\_INT is assigned to a variable and used.

```
g_int1 := SET_BIT_OF_INT(TRUE, 0);
```

```
g_bool1 := GET_BIT_OF_INT(g_int1, 0);
```

The return value of SET\_BIT\_OF\_INT(\_E) also works as input/output. Do not directly assign it to the input argument of another instruction, function, or function block.

//In the following program, the value of the first argument of GET\_BIT\_OF\_INT is undefined.

```
g_bool1 := GET_BIT_OF_INT( SET_BIT_OF_INT(TRUE, 0), 0);
```

## Operation error

There is no operation error.

### Point

By using the bit specification of labels, a concise program having the same operation as SET\_BIT\_OF\_INT can be created.

The following example changes the value in bit 5 (b5) of g\_int1 to the value of g\_bool1 the same as when SET\_BIT\_OF\_INT is used.

Ladder



ST

```
g_int1.5 := g_bool1;
```

FBD/LD



# 31.68 Copying the Specified Bit of the Word Label

31

## CPY\_BIT\_OF\_INT(\_E)

These functions copy the specified bit of the word label to the specified bit of another word label.

| Ladder <sup>*1</sup> |               | ST                                                                                                       |
|----------------------|---------------|----------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]     | [With EN/ENO] | [Without EN/ENO]<br>d:=CPY_BIT_OF_INT(s,n1,n2);<br>[With EN/ENO]<br>d:=CPY_BIT_OF_INT_E(EN,ENO,s,n1,n2); |
|                      |               |                                                                                                          |

\*1 FBD/LD is not supported. For FBD/LD, use the bit specification of labels.

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type                  | Data type         |
|----------|-----------------------------------------------------------------|-----------------------|-------------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable        | BOOL              |
| s        | Input                                                           | Input variable        | INT <sup>*1</sup> |
| n1       | Number of bits in input variable (0 to 15)                      | Input variable        | INT               |
| n2       | Number of bits in output variable (0 to 15)                     | Input variable        | INT               |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable       | BOOL              |
| d        | Input/output                                                    | Input/output variable | INT <sup>*1</sup> |

\*1 Digit-specified labels and devices cannot be used.

### Processing details

#### ■Operation processing

These functions copy the value in the (n1)th bit of the word specified by (s) to the (n2)th bit of (d).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Precautions

When using CPY\_BIT\_OF\_INT(\_E) in ST, create a program which assigns the return value to a variable.

//The return value of CPY\_BIT\_OF\_INT is assigned to a variable and used.

```
g_int2 := CPY_BIT_OF_INT(g_int1,5,3);
```

```
g_bool1 := GET_BIT_OF_INT(g_int2,3);
```

The return value of CPY\_BIT\_OF\_INT(\_E) also works as input/output. Do not directly assign it to the input argument of another instruction, function, or function block.

//In the following program, the value of the first argument of GET\_BIT\_OF\_INT is undefined.

```
g_bool1 := GET_BIT_OF_INT( CPY_BIT_OF_INT(g_int1,5,3), 3);
```

## Operation error

There is no operation error.

### Point

By using the bit specification of labels, a concise program having the same operation as CPY\_BIT\_OF\_INT can be created.

The following example changes the value in bit 3 (b3) of g\_int2 to the value of bit 5 (b5) of g\_int1 the same as when CPY\_BIT\_OF\_INT is used.

Ladder



ST

```
g_int2.3 := g_int1.5;
```

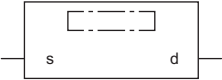
FBD/LD



# 31.69 Getting the Start Data

## GET\_BOOL\_ADDR, GET\_INT\_ADDR, GET\_WORD\_ADDR

These functions output the start data of the specified array as BOOL, INT, or WORD type data.

| Ladder, FBD/LD                                                                    | ST                                                                 |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------|
|  | d:=GET_BOOL_ADDR(s)<br>d:=GET_INT_ADDR(s);<br>d:=GET_WORD_ADDR(s); |

### Setting data

#### ■Description, type, data type

| Argument | Description | Type            | Data type     |
|----------|-------------|-----------------|---------------|
| s        | Input       | Input variable  | ANY           |
| d        | Output      | Output variable | BOOL/INT/WORD |

### Processing details

#### ■Operation processing

- The GET\_BOOL\_ADDR function outputs the start data of the array specified by (s) as BOOL type data.
- The GET\_INT\_ADDR function outputs the start data of the array specified by (s) as INT type data. When the data type whose bit length is 32 bits or longer is specified, the lower 16 bits are acquired.
- The GET\_WORD\_ADDR function outputs the start data of the array specified by (s) as WORD type data. When the data type whose bit length is 32 bits or longer is specified, the lower 16 bits are acquired.

| Standard function | Input data type                                                                                                                              | Output data type |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| GET_BOOL_ADDR     | BOOL<br>ARRAY OF BOOL                                                                                                                        | BOOL             |
| GET_INT_ADDR      | INT                                                                                                                                          | INT              |
| GET_WORD_ADDR     | DINT<br>WORD<br>REAL<br>TIME<br>STRING<br>ARRAY OF INT<br>ARRAY OF DINT<br>ARRAY OF WORD<br>ARRAY OF DWORD<br>ARRAY OF REAL<br>ARRAY OF TIME | WORD             |

#### ■Operation result

The operation processing is performed. The operation result is output from (d).

### Operation error

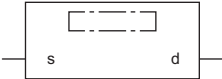
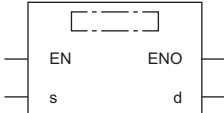
There is no operation error.

# 32 SINGLE VARIABLE FUNCTIONS

## 32.1 Calculating the Absolute Value

### ABS(\_E)

These functions output the absolute value of an input value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=ABS(s);<br>[With EN/ENO]<br>d:=ABS_E(EN,ENO,s); |
|  |  |                                                                        |

#### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_NUM   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_NUM   |

#### Processing details

#### ■Operation processing

- These functions output the absolute value of the INT, DINT, REAL, or LREAL data type value input to (s), in the same type of data as (s), from (d).
- When the input value is defined as A and the output value is defined as B, the relationship of A and B will be as follows:  
 $B = |A|$
- Input an INT, DINT, REAL, or LREAL data type value to (s).
- If -32768 in INT data type is input to (s), (d) will output -32768.
- If -2147483648 in DINT data type is input to (s), (d) will output -2147483648. (No operation error occurs. When ABS\_E is used, ENO outputs TRUE.)

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

- When (s) is of REAL data type

| Error code (SD0) | Description                                                                               |
|------------------|-------------------------------------------------------------------------------------------|
| 3282H            | The value output from (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

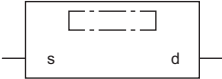
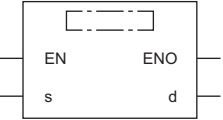
- When (s) is of LREAL data type

| Error code (SD0) | Description                                                                               |
|------------------|-------------------------------------------------------------------------------------------|
| 3282H            | The value output from (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

## 32.2 Calculating the Square Root

### SQRT(\_E)

These functions calculate the square root of an input value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=SQRT(s);<br>[With EN/ENO]<br>d:=SQRT_E(EN,ENO,s); |
|  |  |                                                                          |

#### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_REAL  |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_REAL  |

#### Processing details

#### ■Operation processing

- These functions calculate the square root of the REAL/LREAL data type value input to (s) and store the operation result in (d).
- When the input value is defined as A and the output value is defined as B, the relationship of A and B will be as follows:

$$B = \sqrt{A}$$

- Input a positive REAL/LREAL data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

#### Operation error

| Error code (SD0) | Description                  |
|------------------|------------------------------|
| 3285H            | The input value is negative. |



## 32.3 Calculating the Natural Logarithm

32

### LN(\_E)

These functions output the natural logarithm (logarithm with base e) of an input value.

| Ladder, FBD/LD   |               | ST                                                                   |
|------------------|---------------|----------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>d:=LN(s);<br>[With EN/ENO]<br>d:=LN_E(EN,ENO,s); |

#### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_REAL  |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_REAL  |

#### Processing details

#### ■Operation processing

- These functions calculate the natural logarithm of the REAL/LREAL data type value input to (s), and output the operation result from (d).
- When the input value is defined as A and the output value is defined as B, the relationship of A and B will be as follows:  
 $B = \log_e A$
- Natural logarithm operation is performed with the base (e) defined as 2.71828.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

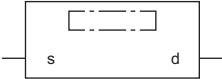
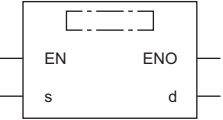
#### Operation error

| Error code (SD0) | Description                       |
|------------------|-----------------------------------|
| 3285H            | The input value is 0 or negative. |

## 32.4 Calculating the Common Logarithm

### LOG(\_E)

These functions output the common logarithm (logarithm with base 10) of an input value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=LOG(s);<br>[With EN/ENO]<br>d:=LOG_E(EN,ENO,s); |
|  |  |                                                                        |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_REAL  |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_REAL  |

### Processing details

#### ■Operation processing

- These functions calculate the common logarithm with base 10 of the REAL or LREAL data type value input to (s), and output the operation result from (d).
- When the input value is defined as A and the output value is defined as B, the relationship of A and B will be as follows:  

$$B = \log_{10} A$$
- Input a REAL or LREAL data type value to (s).
- Input a positive value only. (Calculation cannot be performed with a negative value.)
- If the operation result is -0 or an underflow occurs, 0 will be output as the operation result.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

- When (s) is of REAL data type

| Error code (SD0) | Description                                                                                                                                                         |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                                                              |
| 3285H            | Out-of-range data is set to (s). <ul style="list-style-type: none"> <li>• The specified value is a negative number.</li> <li>• The specified value is 0.</li> </ul> |

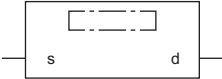
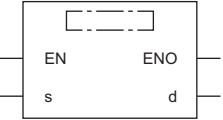
- When (s) is of LREAL data type

| Error code (SD0) | Description                                                                                                                                                         |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                                                                              |
| 3285H            | Out-of-range data is set to (s). <ul style="list-style-type: none"> <li>• The specified value is a negative number.</li> <li>• The specified value is 0.</li> </ul> |

## 32.5 Calculating the Exponent

### EXP(\_E)

These functions output the exponent of an input value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=EXP(s);<br>[With EN/ENO]<br>d:=EXP_E(EN,ENO,s); |
|  |  |                                                                        |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_REAL  |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_REAL  |

### Processing details

#### ■Operation processing

- These functions calculate the exponent of the REAL/LREAL data type value input to (s), and output the operation result from (d).
- When the input value is defined as A and the output value is defined as B, the relationship of A and B will be as follows:  

$$B = e^A$$
- Exponent operation is performed with the base (e) defined as 2.71828.
- Input a REAL or LREAL data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

| Error code (SD0) | Description                                                                                          |
|------------------|------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .               |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ d  < 2^{128}$ |

## 32.6 Calculating the Sine

32

### SIN(\_E)

These functions output the sine of an input value.

| Ladder, FBD/LD   |               | ST                                                                     |
|------------------|---------------|------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>d:=SIN(s);<br>[With EN/ENO]<br>d:=SIN_E(EN,ENO,s); |

#### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_REAL  |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_REAL  |

#### Processing details

#### ■Operation processing

- These functions calculate the sine of the REAL data type value (angle) input to (s), and output the operation result from (d).
- When the input value is defined as A and the output value is defined as B, the relationship of A and B will be as follows:

$$B = \sin A$$

- Input a REAL data type value to (s). Input a value (angle) in radians ( $\text{angle} \times \pi / 180$ ).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

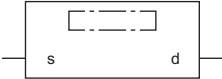
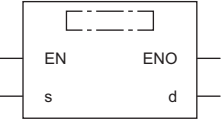
#### Operation error

| Error code (SD0) | Description                      |
|------------------|----------------------------------|
| 3282H            | The data specified by (s) is -0. |

## 32.7 Calculating the Cosine

### COS(\_E)

These functions output the cosine of an input value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=COS(s);<br>[With EN/ENO]<br>d:=COS_E(EN,ENO,s); |
|  |  |                                                                        |

#### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_REAL  |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_REAL  |

#### Processing details

#### ■Operation processing

- These functions calculate the cosine of the REAL data type value (angle) input to (s), and output the operation result from (d).
- When the input value is defined as A and the output value is defined as B, the relationship of A and B will be as follows:  
 $B = \cos A$
- Input a REAL data type value to (s). Input a value (angle) in radians ( $\text{angle} \times \pi / 180$ ).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

#### Operation error

| Error code (SD0) | Description                      |
|------------------|----------------------------------|
| 3282H            | The data specified by (s) is -0. |

## 32.8 Calculating the Tangent

### TAN(\_E)

These functions output the tangent of an input value.

| Ladder, FBD/LD   |               | ST                                                                     |
|------------------|---------------|------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>d:=TAN(s);<br>[With EN/ENO]<br>d:=TAN_E(EN,ENO,s); |

#### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_REAL  |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_REAL  |

#### Processing details

#### ■Operation processing

- These functions calculate the tangent of the REAL data type value (angle) input to (s), and output the operation result from (d).
- When the input value is defined as A and the output value is defined as B, the relationship of A and B will be as follows:  
 $B = \tan A$
- Note that even if the input value is  $\pi/2$  radian or  $(3/2)\pi$  radian, no error will be issued because of the truncation error in the radian value.
- Input a REAL data type value to (s). Input a value (angle) in radians ( $\text{angle} \times \pi / 180$ ).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

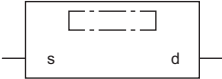
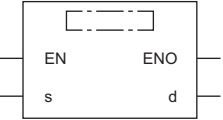
#### Operation error

| Error code (SD0) | Description                      |
|------------------|----------------------------------|
| 3282H            | The data specified by (s) is -0. |

## 32.9 Calculating the Arc Sine

### ASIN(\_E)

These functions output the arc sine ( $\text{SIN}^{-1}$ ) of an input value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=ASIN(s);<br>[With EN/ENO]<br>d:=ASIN_E(EN,ENO,s); |
|  |  |                                                                          |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_REAL  |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_REAL  |

### Processing details

#### ■Operation processing

- These functions calculate the arc sine ( $\text{SIN}^{-1}$ ) of the REAL data type value input to (s), and output the operation result from (d).
- When the input value is defined as A and the output value is defined as B, the relationship of A and B will be as follows:  
 $B = \text{SIN}^{-1} A$
- Input a REAL data type value to (s) within the following range.  
 ASIN(\_E): -1.0 to 1.0
- The value (angle) is output from (d) in radians ( $\text{angle} \times \pi / 180$ ).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

| Error code (SD0) | Description                                              |
|------------------|----------------------------------------------------------|
| 3282H            | The data specified by (s) is -0.                         |
| 3285H            | The value input with ASIN(_E) is other than -1.0 to 1.0. |

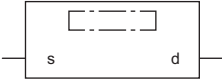
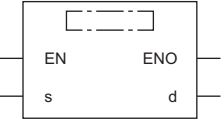


## 32.10 Calculating the Arc Cosine

32

### ACOS(\_E)

These functions output the arc cosine ( $\text{COS}^{-1}$ ) of an input value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=ACOS(s);<br>[With EN/ENO]<br>d:=ACOS_E(EN,ENO,s); |
|  |  |                                                                          |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_REAL  |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_REAL  |

### Processing details

#### ■Operation processing

- These functions calculate the arc cosine ( $\text{COS}^{-1}$ ) of the REAL data type value input to (s), and output the operation result from (d).

- When the input value is defined as A and the output value is defined as B, the relationship of A and B will be as follows:  
 $B = \text{COS}^{-1} A$

- Input a REAL data type value to (s) within the following range.

ACOS(\_E): -1.0 to 1.0

- The value (angle) is output from (d) in radians ( $\text{angle} \times \pi / 180$ ).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

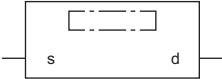
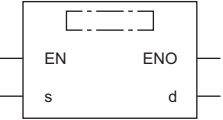
### Operation error

| Error code (SD0) | Description                                              |
|------------------|----------------------------------------------------------|
| 3282H            | The data specified by (s) is -0.                         |
| 3285H            | The value input with ACOS(_E) is other than -1.0 to 1.0. |

# 32.11 Calculating the Arc Tangent

## ATAN(\_E)

These functions output the arc tangent ( $\text{TAN}^{-1}$ ) of an input value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=ATAN(s);<br>[With EN/ENO]<br>d:=ATAN_E(EN,ENO,s); |
|  |  |                                                                          |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_REAL  |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_REAL  |

### Processing details

#### ■Operation processing

- These functions calculate the arc tangent ( $\text{TAN}^{-1}$ ) of the REAL data type value input to (s), and output the operation result from (d).
- When the input value is defined as A and the output value is defined as B, the relationship of A and B will be as follows:  
 $B = \text{TAN}^{-1} A$
- Input a REAL data type value to (s) within the following range.  
 $\text{ATAN}(\_E): \pm 1.17549 \times 10^{-38} \text{ to } \pm 3.40282 \times 10^{38}$
- The value (angle) is output from (d) in radians ( $\text{angle} \times \pi / 180$ ).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

### Operation error

| Error code (SD0) | Description                      |
|------------------|----------------------------------|
| 3282H            | The data specified by (s) is -0. |

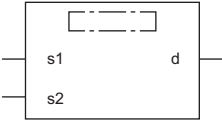
# 33 ARITHMETIC OPERATION FUNCTIONS

33

## 33.1 Addition

### ADD(\_E)

These functions output the sum of input values  $((s1)+(s2)+\dots+(s28))$ .

| Ladder, FBD/LD <sup>*1</sup>                                                      |                                                                                   | ST <sup>*1</sup>                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br><code>d:=ADD(s1,s2);</code><br>[With EN/ENO]<br><code>d:=ADD_E(EN,ENO,s1,s2);</code> |
|  |  |                                                                                                          |

\*1 The input variable s can be changed within the range from 2 to 28.

### Setting data

#### ■Description, type, data type

| Argument               | Description                                               | Type            | Data type |
|------------------------|-----------------------------------------------------------|-----------------|-----------|
| EN                     | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (IN1) to s28 (IN28) | Input                                                     | Input variable  | ANY_NUM   |
| ENO                    | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d                      | Output                                                    | Output variable | ANY_NUM   |

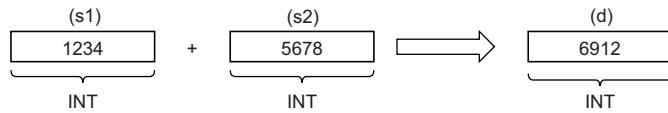
## Processing details

### ■Operation processing

- These functions add the INT, DINT, WORD, DWORD, REAL, or LREAL data type values input to (s1) to (s28) ((s1)+(s2)+...+(s28)), and output the operation result, in the same data type as (s), from (d).

**Ex.**

Data type: INT



- Input an INT, DINT, WORD, DWORD, REAL, or LREAL data type value to (s1) to (s28).
- If an underflow or overflow occurs in the operation result, the output from (d) will be as follows.

| Data type | Description                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INT       | <p>Even if an underflow or overflow occurs, no operation error is issued. When ADD_E is used, ENO outputs TRUE.</p> <p>[Example 1]</p> <p>32767+2=-32767<br/>(7FFFH)+(0002H)=(8001H)<br/>A negative value results because the most significant bit is 1.</p> <p>[Example 2]</p> <p>-32767+(-2)=32766<br/>(8000H)+(FFFEH)=(7FFEH)<br/>A positive value results because the most significant bit is 0.</p>                                         |
| DINT      | <p>Even if an underflow or overflow occurs, no operation error is issued. When ADD_E is used, ENO outputs TRUE.</p> <p>[Example 1]</p> <p>2147483647+2=-2147483647<br/>(7FFFFFFFH)+(00000002H)=(80000001H)<br/>A negative value results because the most significant bit is 1.</p> <p>[Example 2]</p> <p>-2147483648+(-2)=2147483646<br/>(80000000H)+(FFFEH)=(7FFFFFFEH)<br/>A positive value results because the most significant bit is 0.</p> |
| WORD      | <p>Even if an overflow occurs, no operation error is issued. When ADD_E is used, ENO outputs TRUE.</p> <p>[Example]</p> <p>65535 + 1 = 0<br/>(FFFFH) + (0001H) = (0000H)</p>                                                                                                                                                                                                                                                                     |
| DWORD     | <p>Even if an overflow occurs, no operation error is issued. When ADD_E is used, ENO outputs TRUE.</p> <p>[Example]</p> <p>4294967295 + 1 = 0<br/>(FFFFFFFFH) + (00000001H) = (00000000H)</p>                                                                                                                                                                                                                                                    |
| REAL      | An operation error occurs and an undefined value is output.                                                                                                                                                                                                                                                                                                                                                                                      |
| LREAL     |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

- When (s1) to (s28) are of REAL data type

| Error code (SD0) | Description                                                                                                   |
|------------------|---------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) to (s28) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .              |
|                  | The value output from (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                     |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{128}$ |

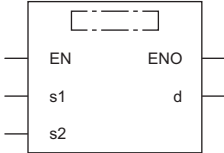
- When (s1) to (s28) are of LREAL data type

| Error code (SD0) | Description                                                                                                    |
|------------------|----------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) to (s28) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .               |
|                  | The value output from (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .                      |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (\text{d})  < 2^{1024}$ |

# 33.2 Multiplication

## MUL(\_E)

These functions output the product of input values ((s1)×(s2)×...×(s28)).

| Ladder, FBD/LD*1                                                                  |                                                                                   | ST*1                                                                           |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=MUL(s1,s2);<br>[With EN/ENO]<br>d:=MUL_E(EN,ENO,s1,s2); |
|  |  |                                                                                |

\*1 The input variable s can be changed within the range from 2 to 28.

## Setting data

### ■Description, type, data type

| Argument               | Description                                               | Type            | Data type |
|------------------------|-----------------------------------------------------------|-----------------|-----------|
| EN                     | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (IN1) to s28 (IN28) | Input                                                     | Input variable  | ANY_NUM   |
| ENO                    | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d                      | Output                                                    | Output variable | ANY_NUM   |

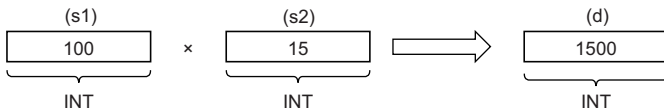
## Processing details

### ■ Operation processing

- These functions multiply the INT, DINT, WORD, DWORD, REAL, or LREAL data type values input to (s1) to (s28)  $((s1) \times (s2) \times \dots \times (s28))$ , and output the operation result, in the same data type as (s), from (d).

**Ex.**

Data type: INT



- Input an INT, DINT, WORD, DWORD, REAL, or LREAL data type value to (s1) to (s28).
- If an underflow or overflow occurs in the operation result, the output from (d) will be as follows.

| Data type     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INT<br>WORD   | <ul style="list-style-type: none"> <li>Even if an underflow or overflow occurs, no operation error is issued. When MUL_E is used, ENO outputs TRUE.</li> <li>Even if the operation result is outside the INT or WORD data type range, the INT or WORD data type value is output; (In this case, the output value is of INT or WORD data type with the upper 16 bits deleted although the operation result is a DINT or DWORD data type value.)</li> <li>If the operation result is outside the INT or WORD data type range, convert the input value to the DINT or DWORD data type by using the INT_TO_DINT or WORD_TO_DWORD function, and then perform operation.</li> </ul> |
| DINT<br>DWORD | <ul style="list-style-type: none"> <li>Even if an underflow or overflow occurs, no operation error is issued. When MUL_E is used, ENO outputs TRUE.</li> <li>Even if the operation result is outside the DINT or DWORD data type range, the DINT or DWORD data type value is output; (In this case, the output value is of DINT or DWORD data type with the upper 32 bits deleted although the operation result is 64-bit data.)</li> <li>If the operation result is outside the DINT or DWORD data type range, convert the input value to the REAL data type by using the DINT_TO_REAL function, and then perform operation.</li> </ul>                                      |
| REAL<br>LREAL | An operation error occurs and an undefined value is output.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

### ■ Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.



If the operation result is outside the data type range, convert the input value as appropriate before operation.

## Operation error

- When (s1) to (s28) are of REAL data type

| Error code (SD0) | Description                                                                                              |
|------------------|----------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) to (s28) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .         |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ < d >  < 2^{128}$ |

- When (s1) to (s28) are of LREAL data type

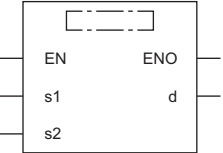
| Error code (SD0) | Description                                                                                               |
|------------------|-----------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) to (s28) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .          |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ < d >  < 2^{1024}$ |



# 33.3 Subtraction

## SUB(\_E)

These functions output the difference between input values ((s1)-(s2)).

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                  |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=SUB(s1,s2);</div> <div>[With EN/ENO]<br/>d:=SUB_E(EN,ENO,s1,s2);</div> |
|  |  |                                                                                                     |

### Setting data

#### ■Description, type, data type

| Argument           | Description                                               | Type            | Data type |
|--------------------|-----------------------------------------------------------|-----------------|-----------|
| EN                 | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (IN1), s2 (IN2) | Input                                                     | Input variable  | ANY_NUM   |
| ENO                | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d                  | Output                                                    | Output variable | ANY_NUM   |

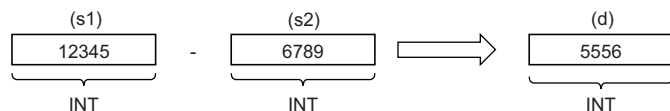
## Processing details

### ■Operation processing

- These functions perform subtraction between the INT, DINT, WORD, DWORD, REAL, or LREAL data type values input to (s1) and (s2) ((s1)-(s2)), and output the operation result, in the same data type as (s), from (d).

**Ex.**

Data type: INT



- Input an INT, DINT, WORD, DWORD, REAL, or LREAL data type value to (s1) and (s2).
- If an underflow or overflow occurs in the operation result, the output from (d) will be as follows.

| Data type | Description                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INT       | <p>Even if an underflow or overflow occurs, no operation error is issued. When SUB_E is used, ENO outputs TRUE.</p> <p>[Example 1]</p> <p>32767-(-2)=-32767<br/>(7FFFH)-(FFFEH)=(8001H)<br/>A negative value results because the most significant bit is 1.</p> <p>[Example 2]</p> <p>-32767-2=32766<br/>(8000H)-(0002H)=(7FFE H)<br/>A positive value results because the most significant bit is 0.</p>                                            |
| DINT      | <p>Even if an underflow or overflow occurs, no operation error is issued. When SUB_E is used, ENO outputs TRUE.</p> <p>[Example 1]</p> <p>2147483647-(-2)=-2147483647<br/>(7FFFFFFFH)-(0000FFFEH)=(80000001H)<br/>A negative value results because the most significant bit is 1.</p> <p>[Example 2]</p> <p>-2147483648-2=2147483646<br/>(80000000H)-(00000002H)=(7FFFFFFEH)<br/>A positive value results because the most significant bit is 0.</p> |
| WORD      | <p>Even if an underflow occurs, no operation error is issued. When ADD_E is used, ENO outputs TRUE.</p> <p>[Example]</p> <p>0 - 1 = 65535<br/>(0000H) - (0001H) = (FFFFH)</p>                                                                                                                                                                                                                                                                        |
| DWORD     | <p>Even if an underflow occurs, no operation error is issued. When ADD_E is used, ENO outputs TRUE.</p> <p>[Example]</p> <p>0 - 1 = 4294967295<br/>(00000000H) - (00000001H) = (FFFFFFFFH)</p>                                                                                                                                                                                                                                                       |
| REAL      | An operation error occurs and an undefined value is output.                                                                                                                                                                                                                                                                                                                                                                                          |
| LREAL     |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

- When (s1) and (s2) are of REAL data type

| Error code (SD0) | Description                                                                                          |
|------------------|------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .              |
|                  | The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .              |
|                  | The value output from (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .            |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ d  < 2^{128}$ |

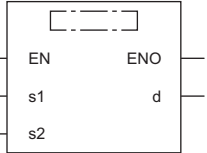
- When (s1) and (s2) are of LREAL data type

| Error code (SD0) | Description                                                                                           |
|------------------|-------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .               |
|                  | The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .               |
|                  | The value output from (d) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .             |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ d  < 2^{1024}$ |

# 33.4 Division

## DIV(\_E)

These functions output the quotient of input values ((s1)÷(s2)).

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                             |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=DIV(s1,s2);<br>[With EN/ENO]<br>d:=DIV_E(EN,ENO,s1,s2); |
|  |  |                                                                                |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (IN1) | Dividend                                                  | Input variable  | ANY_NUM   |
| s2 (IN2) | Divisor                                                   | Input variable  | ANY_NUM   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_NUM   |

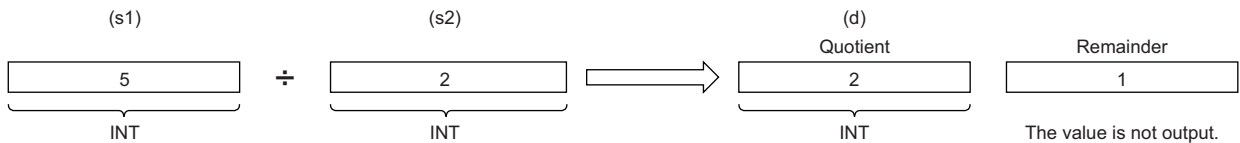
### Processing details

#### ■Operation processing

- These functions perform division between the INT, DINT, WORD, DWORD, REAL, or LREAL data type values input to (s1) and (s2) ((s1)÷(s2)), and output the operation result, in the same data type as (s), from (d).

**Ex.**

Data type: INT



- Input an INT, DINT, WORD, DWORD, REAL, or LREAL data type value to (s1) and (s2). (Note that the value input to (s2) shall be other than 0.)

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

- When (s1) and (s2) are of INT or WORD data type

| Error code (SD0) | Description                             |
|------------------|-----------------------------------------|
| 3280H            | The value (divisor) input to (s2) is 0. |

- When (s1) and (s2) are of DINT or DWORD data type

| Error code (SD0) | Description                             |
|------------------|-----------------------------------------|
| 3280H            | The value (divisor) input to (s2) is 0. |

- When (s1) and (s2) are of REAL data type

| Error code (SD0) | Description                                                                                                                                                                        |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3280H            | The value (divisor) input to (s2) is 0.                                                                                                                                            |
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .<br>The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (d)  < 2^{128}$                                                                             |

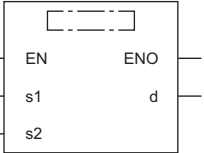
- When (s1) and (s2) are of LREAL data type

| Error code (SD0) | Description                                                                                                                                                                        |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3280H            | The value (divisor) input to (s2) is 0.                                                                                                                                            |
| 3282H            | The value input to (s1) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ .<br>The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |
| 3283H            | The data output from (d) exceeds the following range. (An overflow has occurred.)<br>$ (d)  < 2^{1024}$                                                                            |

# 33.5     Remainder

## MOD(\_E)

These functions output the remainder of input values ((s1)÷(s2)).

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                                              |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>The function is described as an operator. (📄 Page 94 Operators)<br>[With EN/ENO]<br>d:=MOD_E(EN,ENO,s1,s2); |
|  |  |                                                                                                                                 |

## Setting data

### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (IN1) | Dividend                                                  | Input variable  | ANY_INT   |
| s2 (IN2) | Divisor                                                   | Input variable  | ANY_INT   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_INT   |

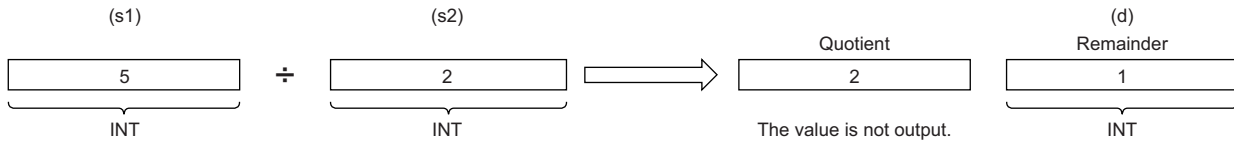
## Processing details

### ■ Operation processing

- These functions perform division between the INT, DINT, WORD, or DWORD data type values input to (s1) and (s2) ((s1)÷(s2)), and output the remainder of the operation result, in the same data type as (s), from (d).

**Ex.**

Data type: INT



- Input an INT, DINT, WORD, or DWORD data type value to (s1) and (s2). (Note that the value input to (s2) shall be other than 0.)

### ■ Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

- When (s1) and (s2) are of INT or WORD data type

| Error code (SD0) | Description                             |
|------------------|-----------------------------------------|
| 3280H            | The value (divisor) input to (s2) is 0. |

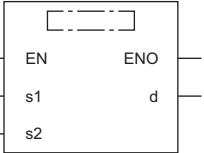
- When (s1) and (s2) are of DINT or DWORD data type

| Error code (SD0) | Description                             |
|------------------|-----------------------------------------|
| 3280H            | The value (divisor) input to (s2) is 0. |

# 33.6 Exponentiation

## EXPT(\_E)

These functions output the exponentiation of an input value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                    |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=EXPT(s1,s2);</div> <div>[With EN/ENO]<br/>d:=EXPT_E(EN,ENO,s1,s2);</div> |
|  |  |                                                                                                       |

## Setting data

### ■Description, type, data type

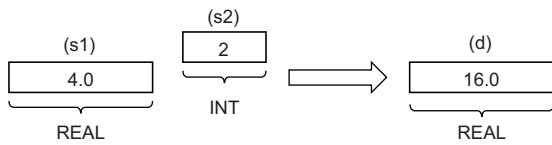
| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (IN1) | Base                                                      | Input variable  | ANY_REAL  |
| s2 (IN2) | Exponent (power)                                          | Input variable  | ANY_NUM   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_REAL  |



## Processing details

### ■Operation processing

These functions exponentiate the REAL or LREAL data type value input to (s1) with the exponent (INT, DINT, REAL, or LREAL data type) input to (s2), and output the operation result from (d).



### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

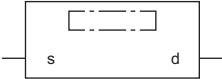
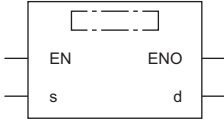
## Operation error

| Error code (SD0) | Description                                                                                     |
|------------------|-------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s1) or (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |

# 33.7 Assignment (Move Operation)

## MOVE(\_E)

These functions output the assignment value of an input value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=MOVE(s);<br>[With EN/ENO]<br>d:=MOVE_E(EN,ENO,s); |
|  |  |                                                                          |

### Setting data

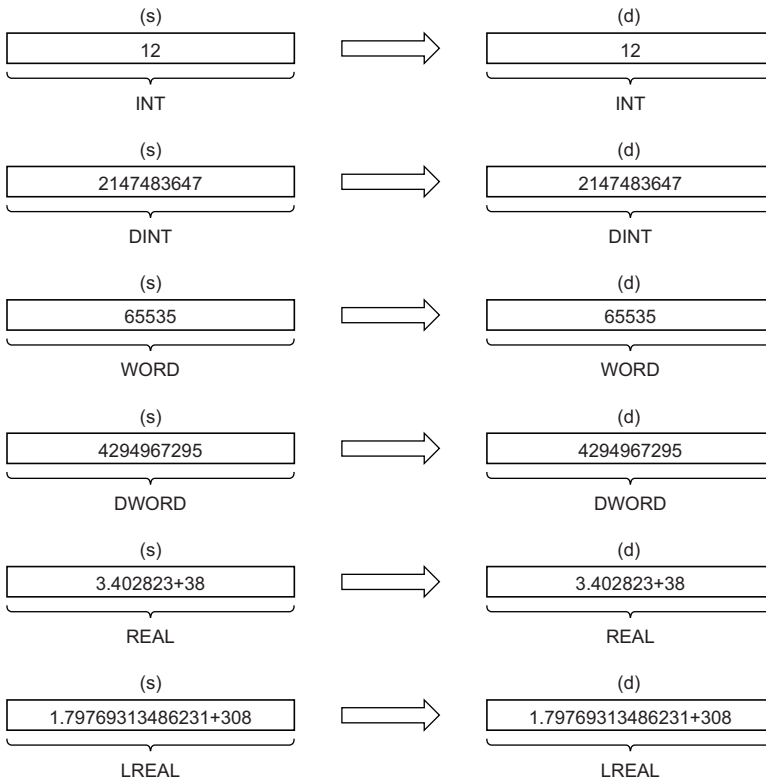
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY       |

## Processing details

### ■Operation processing

- These functions assign the value of the input variable specified by (s) to the output variable specified by (d).
- Input a BOOL, INT, DINT, WORD, DWORD, REAL, LREAL, STRING, TIME, structure, or array data type value to (s) and (d). The values input to (s) and (d) must be of the same data type.



### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

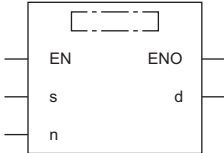
| Error code (SD0) | Description                                                                                                                                                                                    |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | From the device numbers specified in (s) onward, there is no NULL code (00H) in each setting area of the device/label memory.                                                                  |
| 3285H            | The number of characters in the string input to (s) exceeds 16383.                                                                                                                             |
| 3286H            | From the device numbers specified in (d) onward, the specified string cannot be fully stored in each setting area of the device/label memory. (The number of required points is insufficient.) |

# 34 BIT SHIFT FUNCTIONS

## 34.1 Shifting Data to the Left by n Bit(s)

### SHL(\_E)

These functions shift the input value to the left by (n) bit(s), and output the operation result.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=SHL(s,n);<br/>[With EN/ENO]<br/>d:=SHL_E(EN,ENO,s,n);</div> |
|  |  |                                                                                          |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_BIT   |
| n (N)    | Number of bits to be shifted                              | Input variable  | ANY_BIT   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_BIT   |

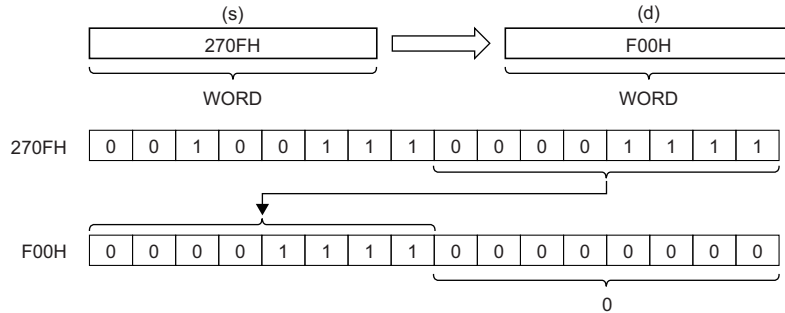
## Processing details

### ■Operation processing

- These functions shift the 16-bit data or 32-bit data (WORD or DWORD data type value) input to (s) to the left by (n) bit(s), and output the operation result, in the same data type as (s), from (d).
- Specify the number of bits to be shifted in (n).

**Ex.**

Data type of (s): 16-bit data (WORD data type), Value input to (n): 8



- The (n) bit(s) from the least significant bit is/are filled with 0(s).
- Input a 16-bit data or 32-bit data (WORD or DWORD data type value) to (s).
- Input a value to (n) (Number of bits to be shifted) within the following range.

| Data type of (s): 16-bit data (WORD data type)                                                                            | Data type of (s): 32-bit data (DWORD data type)                                                                            |
|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Range: 0 to 15<br>The lower 4-bit data is used.<br>[Example]<br>If the input value is 6: 6<br>If the input value is 22: 6 | Range: 0 to 31<br>The lower 5-bit data is used.<br>[Example]<br>If the input value is 6: 6<br>If the input value is 22: 22 |

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

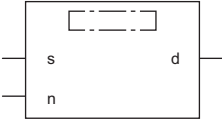
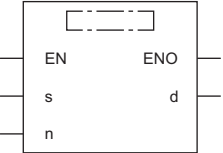
## Operation error

There is no operation error.

# 34.2 Shifting Data to the Right by n Bit(s)

## SHR(\_E)

These functions shift the input value to the right by (n) bit(s), and output the operation result.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=SHR(s,n);<br>[With EN/ENO]<br>d:=SHR_E(EN,ENO,s,n); |
|  |  |                                                                            |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_BIT   |
| n (N)    | Number of bits to be shifted                              | Input variable  | ANY_BIT   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_BIT   |

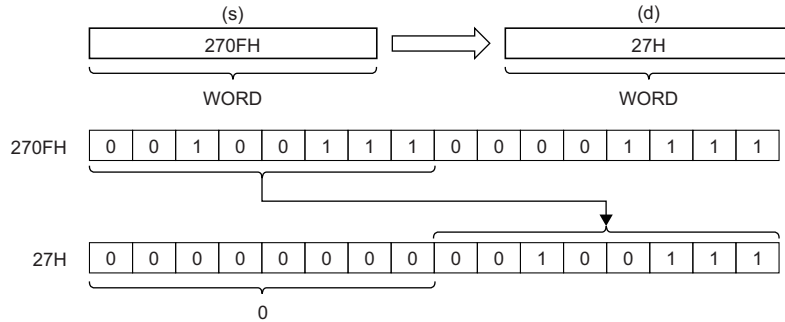
## Processing details

### ■Operation processing

- These functions shift the 16-bit data or 32-bit data (WORD or DWORD data type value) input to (s) to the right by (n) bit(s), and output the operation result, in the same data type as (s), from (d).
- Specify the number of bits to be shifted in (n).

**Ex.**

Data type of (s): 16-bit data (WORD data type), Value input to (n): 8



- The (n) bit(s) from the most significant bit is/are filled with 0(s).
- Input a 16-bit data or 32-bit data (WORD or DWORD data type value) to (s).
- Input a value to (n) (Number of bits to be shifted) within the following range.

| Data type of (s): 16-bit data (WORD data type)                                                                            | Data type of (s): 32-bit data (DWORD data type)                                                                            |
|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Range: 0 to 15<br>The lower 4-bit data is used.<br>[Example]<br>If the input value is 6: 6<br>If the input value is 22: 6 | Range: 0 to 31<br>The lower 5-bit data is used.<br>[Example]<br>If the input value is 6: 6<br>If the input value is 22: 22 |

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

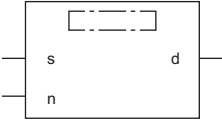
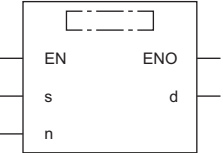
## Operation error

There is no operation error.

# 34.3 Rotating Data to the Left by n Bit(s)

## ROL(\_E)

These functions rotate the input value to the left by (n) bit(s), and output the operation result.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=ROL(s,n);<br>[With EN/ENO]<br>d:=ROL_E(EN,ENO,s,n); |
|  |  |                                                                            |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_BIT   |
| n (N)    | Number of bits to be shifted                              | Input variable  | ANY_BIT   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_BIT   |



## Processing details

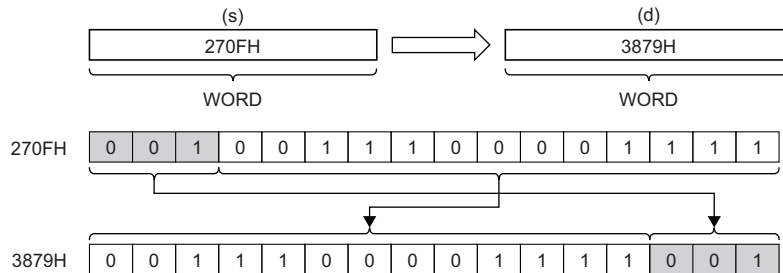
### ■Operation processing

- These functions rotate the 16-bit data or 32-bit data (WORD or DWORD data type value) input to (s) to the left by (n) bit(s), and output the operation result, in the same data type as (s), from (d).
- Specify the number of bits to be rotated in (n).



#### Ex.

Data type of (s): 16-bit data (WORD data type), Value input to (n): 3 (The data rotates to the left by 3 bits.)



- Input a 16-bit data or 32-bit data (WORD or DWORD data type value) to (s).
- Input a value to (n) (Number of bits to be shifted) within the following range.

| Data type of (s): 16-bit data (WORD data type)                                                                            | Data type of (s): 32-bit data (DWORD data type)                                                                            |
|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Range: 0 to 15<br>The lower 4-bit data is used.<br>[Example]<br>If the input value is 6: 6<br>If the input value is 22: 6 | Range: 0 to 31<br>The lower 5-bit data is used.<br>[Example]<br>If the input value is 6: 6<br>If the input value is 22: 22 |

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

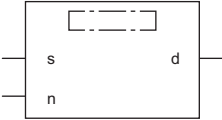
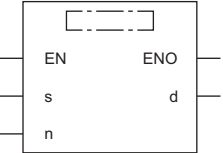
## Operation error

There is no operation error.

# 34.4 Rotating Data to the Right by n Bit(s)

## ROR(\_E)

These functions rotate the input value to the right by (n) bit(s), and output the operation result.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=ROR(s,n);<br>[With EN/ENO]<br>d:=ROR_E(EN,ENO,s,n); |
|  |  |                                                                            |

## Setting data

### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s (IN)   | Input                                                     | Input variable  | ANY_BIT   |
| n (N)    | Number of bits to be shifted                              | Input variable  | ANY_BIT   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_BIT   |

## Processing details

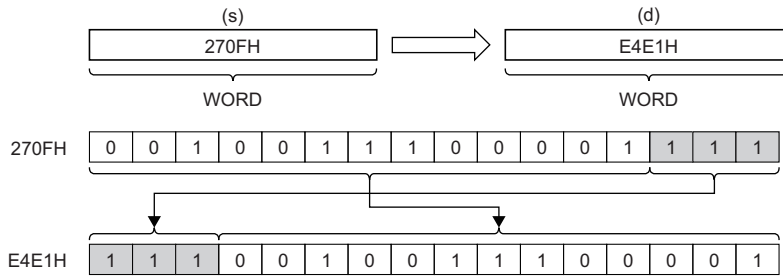
### ■Operation processing

- These functions rotate the 16-bit data or 32-bit data (WORD or DWORD data type value) input to (s) to the right by (n) bit(s), and output the operation result, in the same data type as (s), from (d).
- Specify the number of bits to be rotated in (n).



#### Ex.

Data type of (s): 16-bit data (WORD data type), Value input to (n): 3 (The data rotates to the right by 3 bits.)



- Input a 16-bit data or 32-bit data (WORD or DWORD data type value) to (s).
- Input a value to (n) (Number of bits to be shifted) within the following range.

| Data type of (s): 16-bit data (WORD data type)                                                                            | Data type of (s): 32-bit data (DWORD data type)                                                                            |
|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Range: 0 to 15<br>The lower 4-bit data is used.<br>[Example]<br>If the input value is 6: 6<br>If the input value is 22: 6 | Range: 0 to 31<br>The lower 5-bit data is used.<br>[Example]<br>If the input value is 6: 6<br>If the input value is 22: 22 |

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

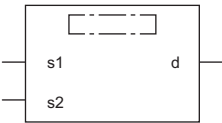
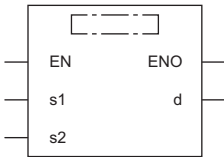
There is no operation error.

# 35    BOOLEAN FUNCTIONS

## 35.1    AND Operation, OR Operation, and XOR Operation

### AND(\_E), OR(\_E), XOR(\_E)

- AND(\_E): These functions output the logical product of input values.
- OR(\_E): These functions output the logical sum of input values.
- XOR(\_E): These functions output the exclusive logical sum of input values.

| Ladder, FBD/LD*1                                                                  |                                                                                   | ST*1                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  |                                                                                   | [Without EN/ENO]<br>The function is described as an operator. (📄 Page 94 Operators)<br>[With EN/ENO]<br>d:=AND_E(EN,ENO,s1,s2);<br>d:=OR_E(EN,ENO,s1,s2);<br>d:=XOR_E(EN,ENO,s1,s2); |
|  |  |                                                                                                                                                                                      |

\*1    The input variable s can be changed within the range from 2 to 28.

### Setting data

#### ■Description, type, data type

| Argument               | Description                                               | Type            | Data type |
|------------------------|-----------------------------------------------------------|-----------------|-----------|
| EN                     | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (IN1) to s28 (IN28) | Input                                                     | Input variable  | ANY_BIT   |
| ENO                    | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d                      | Output                                                    | Output variable | ANY_BIT   |

## Processing details

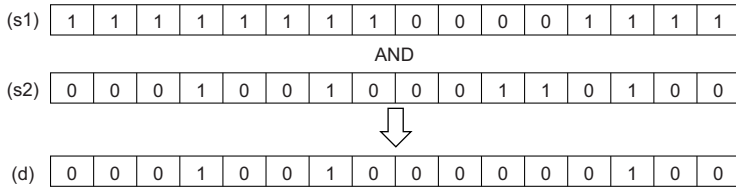
### ■ Operation processing

#### 1. AND(\_E)

These functions perform an AND operation (bit-by-bit) on the BOOL, WORD, or DWORD data type values input to (s1) to (s28), and output the operation result, in the same data type as (s), from (d).

**Ex.**

Data type: WORD

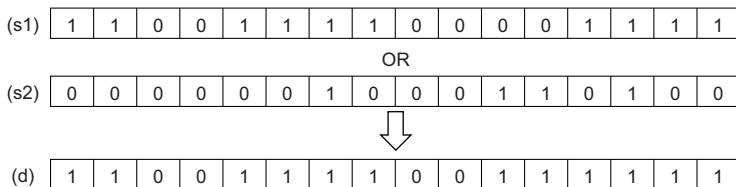


#### 2. OR(\_E)

These functions perform an OR operation (bit-by-bit) on the BOOL, WORD, or DWORD data type values input to (s1) to (s28), and output the operation result, in the same data type as (s), from (d).

**Ex.**

Data type: WORD

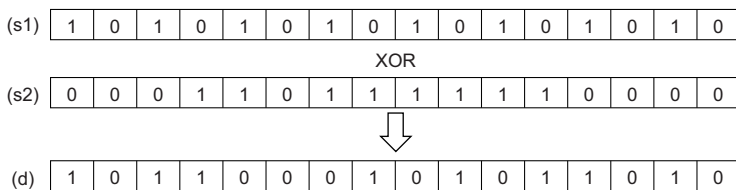


#### 3. XOR(\_E)

- These functions perform an XOR operation (bit-by-bit) on the BOOL, WORD, or DWORD data type values input to (s1) to (s28), and output the operation result, in the same data type as (s), from (d).

**Ex.**

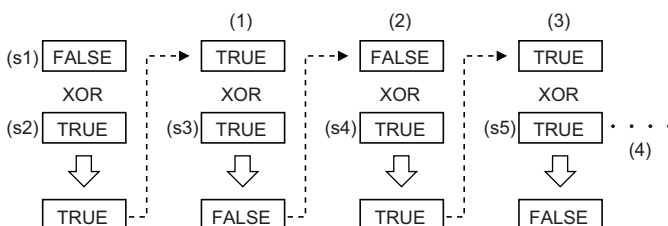
Data type: WORD



- If three or more (s) settings exist, (s3) will be XORed with the result of XOR between (s1) and (s2). In addition, if (s4) exists, (s4) will be XORed with the result of XOR for (s3). After this, XOR will repeat for the number of (s) settings.

**Ex.**

Data type: BOOL



- Number of s's: 3
- Number of s's: 4
- Number of s's: 5
- The XOR operation is repeated by the number of s's.

## ■Operation result

### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

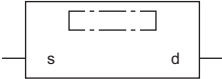
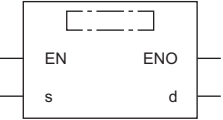
## Operation error

There is no operation error.

## 35.2 NOT Operation

### NOT(\_E)

These functions output the logical NOT of input values.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <p>[Without EN/ENO]<br/>The function is described as an operator. (📖 Page 94 Operators)</p> <p>[With EN/ENO]<br/>d:=NOT_E(EN,ENO,s);</p> |
|  |  |                                                                                                                                          |

#### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s(IN)*1  | Input                                                     | Input variable  | ANY_BIT   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY_BIT   |

\*1 DX cannot be used.

#### Processing details

#### ■Operation processing

- These functions perform a NOT operation (bit-by-bit) on the BOOL, WORD, or DWORD data type value input to (s), and output the operation result, in the same data type as (s), from (d).

**Ex.**

Data type: WORD

|     |     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-----|-----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (s) | 0   | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
|     | NOT |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| (d) | 1   | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

- Input a BOOL, WORD, or DWORD data type value to (s).

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

#### Operation error

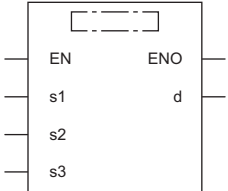
There is no operation error.

# 36 SELECTION FUNCTIONS

## 36.1 Selecting a Value

### SEL(\_E)

These functions output the selected input value.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                 |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=SEL(s1,s2,s3);<br/>[With EN/ENO]<br/>d:=SEL_E(EN,ENO,s1,s2,s3);</div> |
|  |  |                                                                                                    |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (G)   | Output condition (TRUE: s3 output, FALSE: s2 output)      | Input variable  | BOOL      |
| s2 (IN0) | Input                                                     | Input variable  | ANY       |
| s3 (IN1) |                                                           |                 |           |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | ANY       |



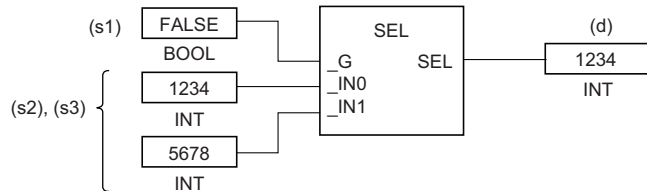
## Processing details

### ■ Operation processing

- These functions output either the (s2) or (s3) input value, in the same data type as (s2) or (s3), from (d) according to the value input to (s1).
- If the value input to (s1) is FALSE (=0), the (s2) input value is output from (d).
- If the value input to (s1) is TRUE (=1), the (s3) input value is output from (d).

#### Ex.

Data type of (s2) and (s3): INT (Argument names (s2) and (s3) correspond to the bit value (0 or 1) of (s1).)



- Input a BOOL data type value to (s1).
- Input a BOOL, INT, DINT, WORD, DWORD, REAL, LREAL, STRING, TIME, structure, or array data type value to (s2) and (s3).

### ■ Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

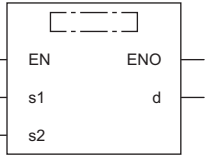
- When (s2) and (s3) are of STRING data type

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the label or device area (between the specified device number and the last device number) specified by (s2).<br>There is no NULL code (00H) in the label or device area (between the specified device number and the last device number) specified by (s3). |
| 3286H            | The entire string cannot be stored in the label or device area (between the specified device number and the last device number) specified by (d). (The number of required points is insufficient.)                                                                                         |

# 36.2     Selecting the Maximum/Minimum Value

## MAX(\_E), MIN(\_E)

- MAX(\_E): These functions output the maximum input value.
- MIN(\_E): These functions output the minimum input value.

| Ladder, FBD/LD*1                                                                                                  |                                                                                                                | ST                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| <div>[Without EN/ENO]<br/></div> | <div>[With EN/ENO]<br/></div> | <div>[Without EN/ENO]<br/>d:=MAX(s1,s2);<br/>d:=MIN(s1,s2);<br/>[With EN/ENO]<br/>d:=MAX_E(EN,ENO,s1,s2);<br/>d:=MIN_E(EN,ENO,s1,s2);</div> |

\*1 The input variable s can be changed within the range from 2 to 28.

## Setting data

### ■Description, type, data type

| Argument               | Description                                               | Type            | Data type      |
|------------------------|-----------------------------------------------------------|-----------------|----------------|
| EN                     | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL           |
| s1 (IN1) to s28 (IN28) | Input                                                     | Input variable  | ANY_ELEMENTARY |
| ENO                    | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL           |
| d                      | Output                                                    | Output variable | ANY_ELEMENTARY |

## Processing details

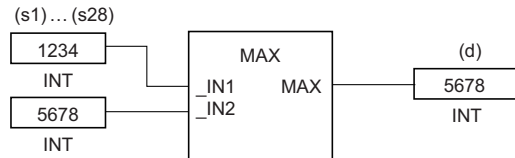
### ■ Operation processing

#### • MAX(\_E)

These functions output the maximum value of the BOOL, INT, DINT, WORD, DWORD, REAL, LREAL, STRING, or TIME data type values input to (s1) to (s28), in the same data type as (s), from (d).

**Ex.**

Data type: INT

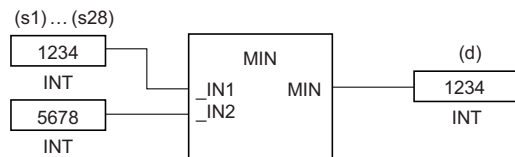


#### • MIN(\_E)

These functions output the minimum value of the BOOL, INT, DINT, WORD, DWORD, REAL, LREAL, STRING, or TIME data type values input to (s1) to (s28), in the same data type as (s), from (d).

**Ex.**

Data type: INT



• Input a BOOL, INT, DINT, WORD, DWORD, REAL, LREAL, STRING, or TIME data type value to (s1) to (s28).

• Conditions for comparing the STRING data type values are as follows:

Match:

• All characters matched

Bigger string:

• The one having a character with a bigger code (when strings consist of different characters)  
• The one having a longer length (when strings are of different lengths)

Smaller string:

• The one having a character with a smaller code (when strings consist of different characters)  
• The one having a shorter length (when strings are of different lengths)

### ■ Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

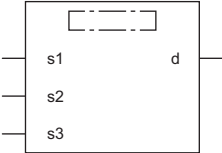
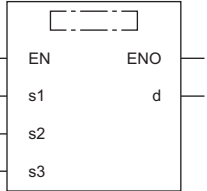
## Operation error

| Error code (SD0) | Description                                                                                                                                                                                    |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | From the device numbers specified by (s1) through (s28) onward, there is no NULL code (00H) in each setting area of the device/label memory.                                                   |
| 3285H            | The number of characters in the strings input to (s1) to (s28) exceeds 16383.                                                                                                                  |
| 3286H            | From the device numbers specified in (d) onward, the specified string cannot be fully stored in each setting area of the device/label memory. (The number of required points is insufficient.) |

# 36.3 Controlling the Upper/Lower Limit

## LIMIT(\_E)

These functions output an input value that has been controlled in terms of the upper and lower limits.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=LIMIT(s1,s2,s3);<br>[With EN/ENO]<br>d:=LIMIT_E(EN,ENO,s1,s2,s3); |
|  |  |                                                                                          |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                  | Type            | Data type      |
|----------|--------------------------------------------------------------|-----------------|----------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)    | Input variable  | BOOL           |
| s1(MN)*1 | Lower limit value (minimum output threshold value)           | Input variable  | ANY_ELEMENTARY |
| s2(IN)*1 | Input value to be controlled with the upper and lower limits | Input variable  | ANY_ELEMENTARY |
| s3(MX)*1 | Upper limit value (maximum output threshold value)           | Input variable  | ANY_ELEMENTARY |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)                | Output variable | BOOL           |
| d        | Output                                                       | Output variable | ANY_ELEMENTARY |

\*1 DX cannot be used.

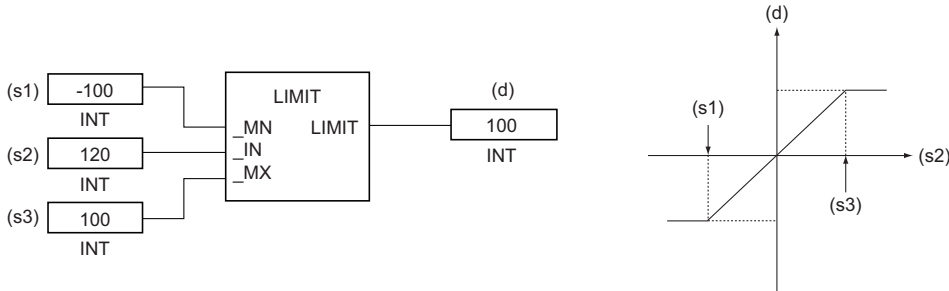
## Processing details

### ■ Operation processing

- These functions output the value, in the same data type as (s1), (s2), or (s3), from (d) according to the BOOL, INT, DINT, WORD, DWORD, REAL, LREAL, STRING, or TIME data type value input to (s1), (s2), and (s3).
- If the input values are  $(s2) > (s3)$ , the value input to (s3) is output from (d).
- If the input values are  $(s2) < (s1)$ , the value input to (s1) is output from (d).
- If the input values are  $(s1) \leq (s2) \leq (s3)$ , the value input to (s2) is output from (d).

**Ex.**

Data type: INT



- Input a BOOL, INT, DINT, WORD, DWORD, REAL, LREAL, STRING, or TIME data type value to (s1), (s2), and (s3), provided that the input value is  $(s1) < (s3)$ .
- Conditions for comparing the STRING data type values are as follows:
  - Match:
    - All characters matched
  - Bigger string:
    - The one having a character with a bigger code (when strings consist of different characters)
    - The one having a longer length (when strings are of different lengths)
  - Smaller string:
    - The one having a character with a smaller code (when strings consist of different characters)
    - The one having a shorter length (when strings are of different lengths)

### ■ Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

- When (s1), (s2), and (s3) are of INT or WORD data type

| Error code (SD0) | Description                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------|
| 3285H            | The lower limit value specified by (s1) is greater than the upper limit value specified by (s2). |

- When (s1), (s2), and (s3) are of DINT, DWORD, or TIME data type

| Error code (SD0) | Description                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------|
| 3285H            | The lower limit value specified by (s1) is greater than the upper limit value specified by (s2). |

- When (s1), (s2), or (s3) are of BOOL data type

| Error code (SD0) | Description                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------|
| 3285H            | The lower limit value specified by (s1) is greater than the upper limit value specified by (s3). |

- When (s1), (s2), and (s3) are of REAL data type

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | <p>The value input to (s1) is out of the following range:<br/> <math>-2^{128} &lt; (s1) \leq -2^{-126}</math>, 0, <math>2^{-126} \leq (s1) &lt; 2^{128}</math><br/> (E-3.40282347+38 to E-1.17549435-38, 0, E1.17549435-38 to E3.40282347+38)</p> <p>The value input to (s1) is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</p> <p>The value input to (s2) is out of the following range:<br/> <math>-2^{128} &lt; (s2) \leq -2^{-126}</math>, 0, <math>2^{-126} \leq (s2) &lt; 2^{128}</math><br/> (E-3.40282347+38 to E-1.17549435-38, 0, E1.17549435-38 to E3.40282347+38)</p> <p>The value input to (s2) is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</p> <p>The value input to (s3) is out of the following range:<br/> <math>-2^{128} &lt; (s3) \leq -2^{-126}</math>, 0, <math>2^{-126} \leq (s3) &lt; 2^{128}</math><br/> (E-3.40282347+38 to E-1.17549435-38, 0, E1.17549435-38 to E3.40282347+38)</p> <p>The value input to (s3) is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</p> |
| 3285H            | The lower limit value specified by (s1) is greater than the upper limit value specified by (s3).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

- When (s1), (s2), and (s3) are of LREAL data type

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | <p>The value input to (s1) is out of the following range:<br/> <math>-2^{1024} &lt; (s1) \leq -2^{-1022}</math>, 0, <math>2^{-1022} \leq (s1) &lt; 2^{1024}</math><br/> (E-1.7976931348623157+308 to E-2.2250738585072014-308, 0, E2.2250738585072014-308 to E1.7976931348623157+308)</p> <p>The value input to (s1) is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</p> <p>The value input to (s2) is out of the following range:<br/> <math>-2^{1024} &lt; (s2) \leq -2^{-1022}</math>, 0, <math>2^{-1022} \leq (s2) &lt; 2^{1024}</math><br/> (E-1.7976931348623157+308 to E-2.2250738585072014-308, 0, E2.2250738585072014-308 to E1.7976931348623157+308)</p> <p>The value input to (s2) is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</p> <p>The value input to (s3) is out of the following range:<br/> <math>-2^{1024} &lt; (s3) \leq -2^{-1022}</math>, 0, <math>2^{-1022} \leq (s3) &lt; 2^{1024}</math><br/> (E-1.7976931348623157+308 to E-2.2250738585072014-308, 0, E2.2250738585072014-308 to E1.7976931348623157+308)</p> <p>The value input to (s3) is -0, a subnormal number, NaN (not a number), or <math>\pm\infty</math>.</p> |
| 3285H            | The lower limit value specified by (s1) is greater than the upper limit value specified by (s3).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

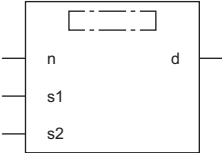
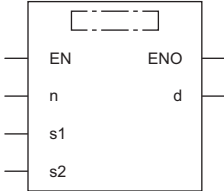
- When (s1), (s2), and (s3) are of STRING data type

| Error code (SD0) | Description                                                                                                                                                                                         |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the label or device area (between the specified device number and the last device number) specified by (s1), (s2), or (s3).                                          |
| 3285H            | <p>The lower limit value specified by (s1) is greater than the upper limit value specified by (s3).</p> <p>The number of characters in the strings input to (s1), (s2), and (s3) exceeds 16383.</p> |
| 3286H            | The entire string cannot be stored in the label or device area (between the specified device number and the last device number) specified by (d). (The number of required points is insufficient.)  |

# 36.4 Multiplexer

## MUX(\_E)

These functions output one of the input values.

| Ladder, FBD/LD*1                                                                  |                                                                                   | ST*1                                                                               |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=MUX(n,s1,s2);<br>[With EN/ENO]<br>d:=MUX_E(EN,ENO,n,s1,s2); |
|  |  |                                                                                    |

\*1 The input variable s can be changed within the range from 2 to 28.

## Setting data

### ■Description, type, data type

| Argument               | Description                                               | Type            | Data type |
|------------------------|-----------------------------------------------------------|-----------------|-----------|
| EN                     | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| n(K)                   | Output value selection                                    | Input variable  | ANY_INT   |
| s1 (IN0) to s28 (IN27) | Input                                                     | Input variable  | ANY       |
| ENO                    | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d                      | Output                                                    | Output variable | ANY       |

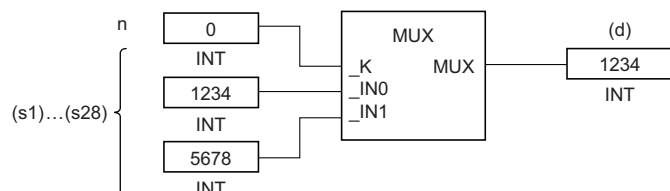
## Processing details

### ■Operation processing

- These functions output one of the values input to (s1) to (s28), in the same data type as (s), from (d) according to the value input to (n).
- If the (n) input value is 0, the value input to (s1) is output from (d).
- If the (n) input value is (n)-1, the value input to (sn) is output from (d).

**Ex.**

Data type: INT



- If a value outside the range of the number of pins in (s) is input to (n), an undefined value is output from (d). (No operation error occurs. When MUX\_E is used, ENO outputs FALSE.)
- Input an INT, DINT, WORD, DWORD data type value to (n) within the range of 0 to 27, provided that it is within the range of the number of pins in (s).
- Input a BOOL, INT, DINT, WORD, DWORD, REAL, LREAL, STRING, TIME, structure, or array data type value to (s).

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                    |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | From the device numbers specified by (s1) through (s28) onward, there is no NULL code (00H) in each setting area of the device/label memory.                                                   |
| 3285H            | The number of characters in the strings input to (s1) to (s28) exceeds 16383.                                                                                                                  |
| 3286H            | From the device numbers specified in (d) onward, the specified string cannot be fully stored in each setting area of the device/label memory. (The number of required points is insufficient.) |



# 37 COMPARISON FUNCTIONS

37

## 37.1 Comparing Data

### GT(\_E), GE(\_E), EQ(\_E), LE(\_E), LT(\_E)

These functions output the comparison result of input values.

| Ladder, FBD/LD <sup>*1</sup> |               | ST <sup>*1</sup>                                                                                                                                                                                                                                         |
|------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]             | [With EN/ENO] | [Without EN/ENO]<br>d:=GT(s1,s2);<br>d:=GE(s1,s2);<br>d:=EQ(s1,s2);<br>d:=LE(s1,s2);<br>d:=LT(s1,s2);<br>[With EN/ENO]<br>d:=GT_E(EN,ENO,s1,s2);<br>d:=GE_E(EN,ENO,s1,s2);<br>d:=EQ_E(EN,ENO,s1,s2);<br>d:=LE_E(EN,ENO,s1,s2);<br>d:=LT_E(EN,ENO,s1,s2); |

\*1 The input variable s can be changed within the range from 2 to 28.

### Setting data

#### ■Description, type, data type

| Argument                             | Description                                               | Type            | Data type      |
|--------------------------------------|-----------------------------------------------------------|-----------------|----------------|
| EN                                   | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL           |
| s1 (IN1) to s28 (IN28) <sup>*1</sup> | Input                                                     | Input variable  | ANY_ELEMENTARY |
| ENO                                  | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL           |
| d                                    | Output (TRUE, FALSE)                                      | Output variable | BOOL           |

\*1 DX cannot be used.

## Processing details

### ■Operation processing

- These functions perform comparison operation between the input values to (s), and output the operation result, in the BOOL data type, from (d).
- GT(\_E): Performs comparison of  $[(s1) > (s2)] \& [(s2) > (s3)] \& \dots \& [(s)_{(n-1)} > (s)_{(n)}]$ .
  - If all values satisfy  $(s)_{(n-1)} > (s)_{(n)}$ , TRUE is output.
  - If one of the values satisfies  $(s)_{(n-1)} \leq (s)_{(n)}$ , FALSE is output.
- GE(\_E): Performs comparison of  $[(s1) \geq (s2)] \& [(s2) \geq (s3)] \& \dots \& [(s)_{(n-1)} \geq (s)_{(n)}]$ .
  - If all values satisfy  $(s)_{(n-1)} \geq (s)_{(n)}$ , TRUE is output.
  - If one of the values satisfies  $(s)_{(n-1)} < (s)_{(n)}$ , FALSE is output.
- EQ(\_E): Performs comparison of  $[(s1) = (s2)] \& [(s2) = (s3)] \& \dots \& [(s)_{(n-1)} = (s)_{(n)}]$ .
  - If all values satisfy  $(s)_{(n-1)} = (s)_{(n)}$ , TRUE is output.
  - If one of the values satisfies  $(s)_{(n-1)} \neq (s)_{(n)}$ , FALSE is output.
- LE(\_E): Performs comparison of  $[(s1) \leq (s2)] \& [(s2) \leq (s3)] \& \dots \& [(s)_{(n-1)} \leq (s)_{(n)}]$ .
  - If all values satisfy  $(s)_{(n-1)} \leq (s)_{(n)}$ , TRUE is output.
  - If one of the values satisfies  $(s)_{(n-1)} > (s)_{(n)}$ , FALSE is output.
- LT(\_E): Performs comparison of  $[(s1) < (s2)] \& [(s2) < (s3)] \& \dots \& [(s)_{(n-1)} < (s)_{(n)}]$ .
  - If all values satisfy  $(s)_{(n-1)} < (s)_{(n)}$ , TRUE is output.
  - If one of the values satisfies  $(s)_{(n-1)} \geq (s)_{(n)}$ , FALSE is output.
- Input an INT, DINT, REAL, LREAL, BOOL, WORD, DWORD, TIME, or STRING type data value to (s). No WSTRING type Unicode string can be specified.
- Conditions for comparing the STRING data type values are as follows:
  - Match:
    - All characters matched
  - Bigger string:
    - The one having a character with a bigger code (when strings consist of different characters)
    - The one having a longer length (when strings are of different lengths)
  - Smaller string:
    - The one having a character with a smaller code (when strings consist of different characters)
    - The one having a shorter length (when strings are of different lengths)

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                    |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | From the device numbers specified by (s1) through (s28) onward, there is no NULL code (00H) in each setting area of the device/label memory.                                                   |
| 3285H            | The number of characters in the strings input to (s1) to (s28) exceeds 16383.                                                                                                                  |
| 3286H            | From the device numbers specified in (d) onward, the specified string cannot be fully stored in each setting area of the device/label memory. (The number of required points is insufficient.) |

## 37.2 Comparing Data

37

### NE(\_E)

These functions output the comparison result of input values.

| Ladder, FBD/LD   |               | ST                                                                           |
|------------------|---------------|------------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>d:=NE(s1,s2);<br>[With EN/ENO]<br>d:=NE_E(EN,ENO,s1,s2); |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type      |
|----------|-----------------------------------------------------------|-----------------|----------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL           |
| s1, s2   | Input                                                     | Input variable  | ANY_ELEMENTARY |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL           |
| d        | Output (TRUE, FALSE)                                      | Output variable | BOOL           |

### Processing details

#### ■Operation processing

- These functions perform comparison operation between the input values to (s), and output the operation result, in the BOOL data type, from (d).
- NE(\_E): Performs comparison of [(s1)≠(s2)].
  - If (s1)≠(s2), TRUE is output.
  - If (s1)=(s2), FALSE is output.
- Input an INT, DINT, REAL, LREAL, BOOL, WORD, DWORD, TIME, or STRING type data value to (s). No WSTRING type Unicode string can be specified.
- Conditions for comparing the STRING data type values are as follows:
  - Match:
    - All characters matched
  - Bigger string:
    - The one having a character with a bigger code (when strings consist of different characters)
    - The one having a longer length (when strings are of different lengths)
  - Smaller string:
    - The one having a character with a smaller code (when strings consist of different characters)
    - The one having a shorter length (when strings are of different lengths)

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                    |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | From the device numbers specified in (s) onward, there is no NULL code (00H) in each setting area of the device/label memory.                                                                  |
| 3285H            | The number of characters in the string input to (s) exceeds 16383.                                                                                                                             |
| 3286H            | From the device numbers specified in (d) onward, the specified string cannot be fully stored in each setting area of the device/label memory. (The number of required points is insufficient.) |

# 38 STRING FUNCTIONS

38

## 38.1 Detecting a String Length

### LEN(\_E)

These functions detect and output the length of the string input.

| Ladder, FBD/LD                                                                 | ST                                                                                                            |
|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| <div> <div>[Without EN/ENO]</div> </div> <div> <div>[With EN/ENO]</div> </div> | <div>[Without EN/ENO]</div> <code>d:=LEN(s);</code> <div>[With EN/ENO]</div> <code>d:=LEN_E(EN,ENO,s);</code> |

### Setting data

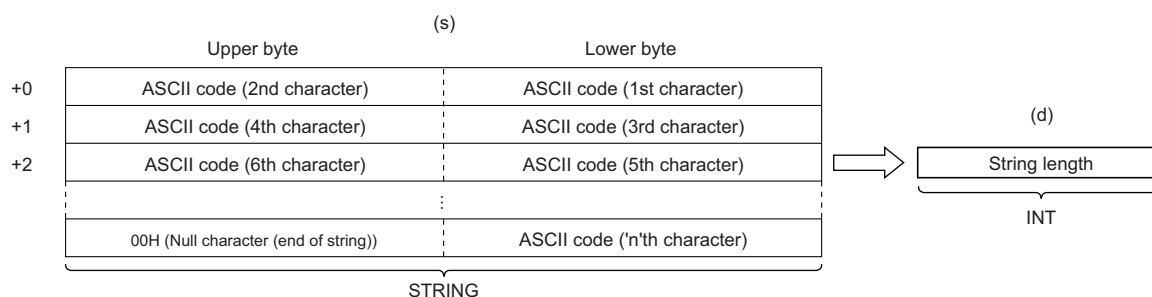
#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type        |
|----------|-----------------------------------------------------------|-----------------|------------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL             |
| s (IN)   | Input                                                     | Input variable  | ANYSTRING_SINGLE |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL             |
| d        | Output                                                    | Output variable | INT              |

### Processing details

#### ■Operation processing

- These functions detect the length of the string input to (s), and output the length from (d).



- Input a STRING data type value to (s) within the range of 0 to 255 bytes.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE*1          | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

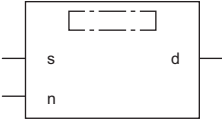
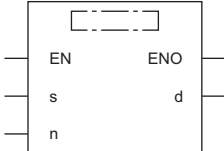
| Error code (SD0) | Description                                                                                                                   |
|------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | From the device numbers specified in (s) onward, there is no NULL code (00H) in each setting area of the device/label memory. |
| 3285H            | The number of characters in the string input to (s) exceeds 16383.                                                            |

## 38.2 Extracting String Data From the Left/Right

38

### LEFT(\_E), RIGHT(\_E)

- LEFT(\_E): These functions extract and output the specified number of characters, starting from the left end of the string input.
- RIGHT(\_E): These functions extract and output the specified number of characters, starting from the right end of the string input.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                                        |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=LEFT(s,n);<br>d:=RIGHT(s,n);<br>[With EN/ENO]<br>d:=LEFT_E(EN,ENO,s,n);<br>d:=RIGHT_E(EN,ENO,s,n); |
|  |  |                                                                                                                           |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type        |
|----------|-----------------------------------------------------------|-----------------|------------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL             |
| s (IN)   | Input                                                     | Input variable  | ANYSTRING_SINGLE |
| n (L)    | Number of characters to be extracted                      | Input variable  | INT              |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL             |
| d        | Output                                                    | Output variable | ANYSTRING_SINGLE |

## Processing details

### ■Operation processing

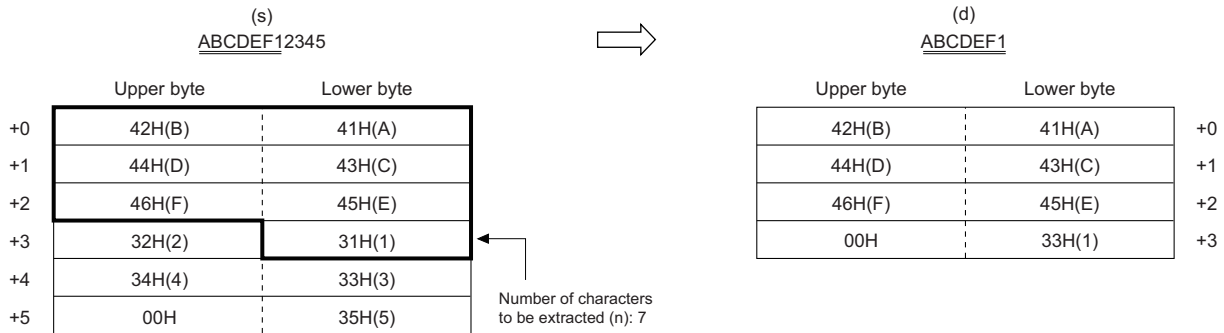
#### • LEFT(\_E)

These functions extract the specified number of characters, starting from the left end of the string input to (s), and output the operation result from (d).

Specify the number of characters to be extracted in (n).

**Ex.**

When (n)=7



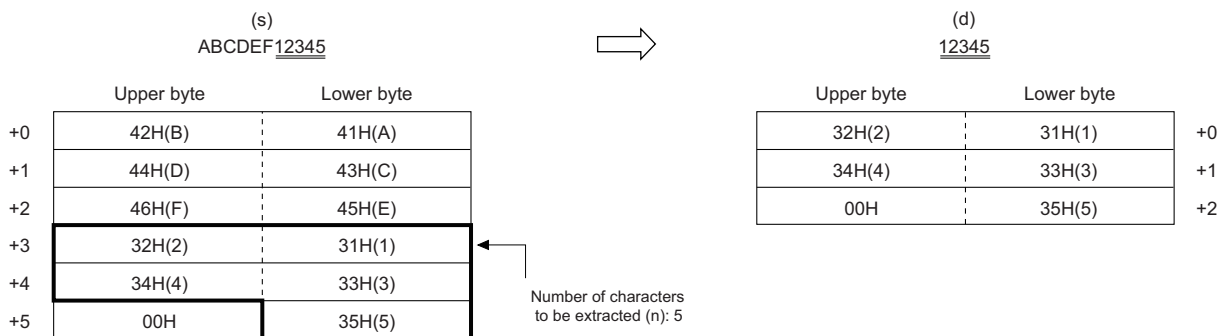
#### • RIGHT(\_E)

These functions extract the specified number of characters, starting from the right end of the string input to (s), and output the operation result from (d).

Specify the number of characters to be extracted in (n).

**Ex.**

When (n)=5



- Input a STRING data type value to (s) within the range of 0 to 255 bytes.
- Input an INT data type value to (n) within the range of 0 to 255, provided that it is within the number of characters in the string input to (s).

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.



## Operation error

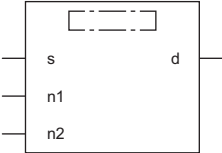
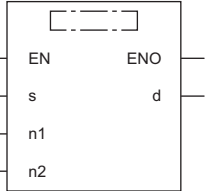
38

| Error code (SD0) | Description                                                                                                                   |
|------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | From the device numbers specified in (s) onward, there is no NULL code (00H) in each setting area of the device/label memory. |
| 3285H            | The number of characters in the string input to (s) exceeds 16383.                                                            |
|                  | The number of characters in the string input to (s) is 0.                                                                     |
|                  | The value input to (n) exceeds the number of characters in (s).                                                               |

# 38.3     Extracting String Data

## MID(\_E)

These functions extract and output the specified number of characters, starting from the specified position of the string input.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                 |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=MID(s,n1,n2);<br>[With EN/ENO]<br>d:=MID_E(EN,ENO,s,n1,n2); |
|  |  |                                                                                    |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type        |
|----------|-----------------------------------------------------------|-----------------|------------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL             |
| s (IN)   | Input                                                     | Input variable  | ANYSTRING_SINGLE |
| n1 (L)   | Number of characters to be extracted                      | Input variable  | INT              |
| n2 (P)   | Extraction target character start position                | Input variable  | INT              |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL             |
| d        | Output                                                    | Output variable | ANYSTRING_SINGLE |

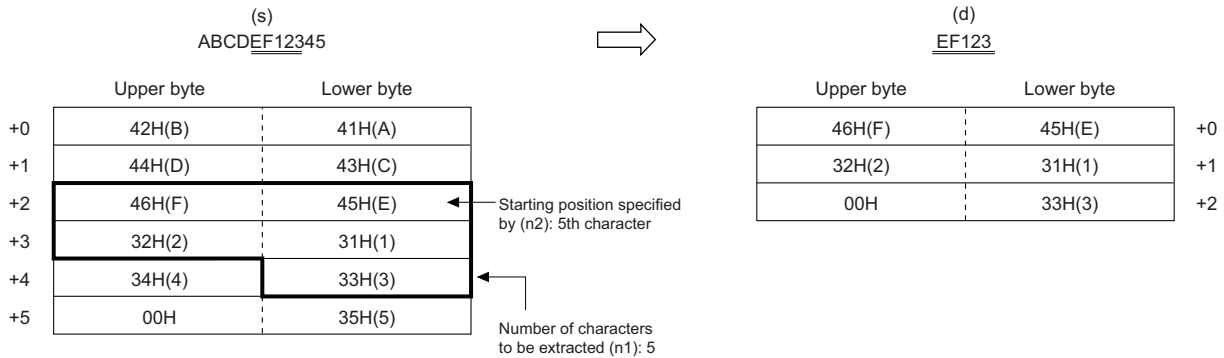
## Processing details

### ■Operation processing

- These functions extract the specified number of characters, starting from the specified position of the string input to (s), and output the operation result from (d).
- Specify the number of characters to be extracted in (n1).
- Specify the start position of the string to be extracted in (n2).

**Ex.**

When (n1)=5, (n2)=5



- Input a STRING data type value to (s) within the range of 0 to 255 bytes.
- Input an INT data type value to (n1) within the range of 0 to 255, provided that it is within the number of characters in the string input to (s).
- Input an INT data type value to (n2) within the range of 1 to 255, provided that it is within the number of characters in the string input to (s).

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

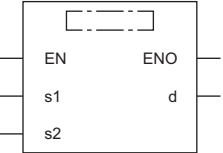
## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | From the device numbers specified in (s) onward, there is no NULL code (00H) in each setting area of the device/label memory.                                                                                                                                                                                                                                                                                                                                                    |
| 3285H            | <p>The number of characters in the string input to (s) exceeds 16383.</p> <p>Out-of-range data is set to (n1) or (n2).</p> <ul style="list-style-type: none"> <li>• The value input to (n1) or (n2) is 0 or smaller.</li> <li>• The value input to (n2) is other than the valid values (-1, 0, 1 or bigger).</li> <li>• The value input to (n1) exceeds the number of characters in (s).</li> <li>• The sum of (n1) and (n2) exceeds the number of characters in (s).</li> </ul> |

# 38.4 Concatenating String Data

## CONCAT(\_E)

These functions concatenate strings, and output the operation result.

| Ladder, FBD/LD <sup>*1</sup>                                                      |                                                                                   | ST <sup>*1</sup>                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=CONCAT(s1,s2);<br>[With EN/ENO]<br>d:=CONCAT_E(EN,ENO,s1,s2); |
|  |  |                                                                                      |

<sup>\*1</sup> The input variable s can be changed within the range from 2 to 28.

### Setting data

#### ■Description, type, data type

| Argument               | Description                                               | Type            | Data type        |
|------------------------|-----------------------------------------------------------|-----------------|------------------|
| EN                     | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL             |
| s1 (IN1) to s28 (IN28) | Input                                                     | Input variable  | ANYSTRING_SINGLE |
| ENO                    | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL             |
| d                      | Output                                                    | Output variable | ANYSTRING_SINGLE |

### Processing details

#### ■Operation processing

- These functions concatenate the strings input to (s2) to (s28) to the end of the string input to (s1), and output the operation result from (d).
- The (s2) to (s28) strings are concatenated successively, ignoring 00H, which indicates the end of the (s1) string.
- If the string after concatenation exceeds 255 bytes, the substring up to the 255th byte will be output.

| (s1)<br><u>ABCDE</u> |            |            | + | (s2)<br><u>123456</u> |            |            | ⇒ | (d)<br><u>ABCDE123456</u> |            |            |
|----------------------|------------|------------|---|-----------------------|------------|------------|---|---------------------------|------------|------------|
|                      | Upper byte | Lower byte |   |                       | Upper byte | Lower byte |   |                           | Upper byte | Lower byte |
| +0                   | 42H(B)     | 41H(A)     |   | +0                    | 32H(2)     | 31H(1)     |   | +0                        | 42H(B)     | 41H(A)     |
| +1                   | 44H(D)     | 43H(C)     |   | +1                    | 34H(4)     | 33H(3)     |   | +1                        | 44H(D)     | 43H(C)     |
| +2                   | 00H        | 45H(E)     |   | +2                    | 36H(6)     | 35H(5)     |   | +2                        | 31H(1)     | 45H(E)     |
|                      |            |            |   | +3                    | 00H        |            |   | +3                        | 33H(3)     | 32H(2)     |
|                      |            |            |   |                       |            |            |   | +4                        | 35H(5)     | 34H(4)     |
|                      |            |            |   |                       |            |            |   | +5                        | 00H        | 36H(6)     |

- Input a STRING data type value to (s1) and (s2) to (s28) within the range of 0 to 255 bytes.

#### ■Operation result

##### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

##### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

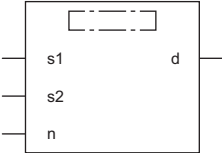
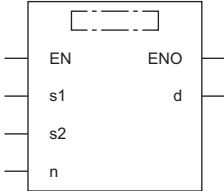
<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

| Error code (SD0) | Description                                                                                                                                                                                                        |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | From the device numbers specified by (s1) through (s28) onward, there is no NULL code (00H) in each setting area of the device/label memory.                                                                       |
|                  | There is no NULL code (00H) in each setting area in the device/label memory in the device specified by (d) and later.                                                                                              |
| 2821H            | The device numbers are overlapping between (s1) to (s28) and (d).                                                                                                                                                  |
| 3285H            | The number of characters in the strings input to (s1) to (s28) exceeds 16383.                                                                                                                                      |
|                  | The number of characters in the strings input to (s1) to (s28) is 0.                                                                                                                                               |
|                  | The number of characters of the string in the device specified by (d) exceeds 16383.                                                                                                                               |
| 3286H            | From the device numbers specified in (d) onward, the entire string after concatenate processing cannot be stored in each setting area of the device/label memory. (The number of required points is insufficient.) |

# 38.5 Inserting String Data

## INSERT(\_E)

These functions insert a string into another string, and output the operation result.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                            |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=INSERT(s1,s2,n);</div> <div>[With EN/ENO]<br/>d:=INSERT_E(EN,ENO,s1,s2,n);</div> |
|  |  |                                                                                                               |

### Setting data

#### ■Description, type, data type

| Argument           | Description                                               | Type            | Data type        |
|--------------------|-----------------------------------------------------------|-----------------|------------------|
| EN                 | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL             |
| s1 (IN1), s2 (IN2) | Input                                                     | Input variable  | ANYSTRING_SINGLE |
| n (P)              | Insertion target character start position                 | Input variable  | INT              |
| ENO                | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL             |
| d                  | Output                                                    | Output variable | ANYSTRING_SINGLE |

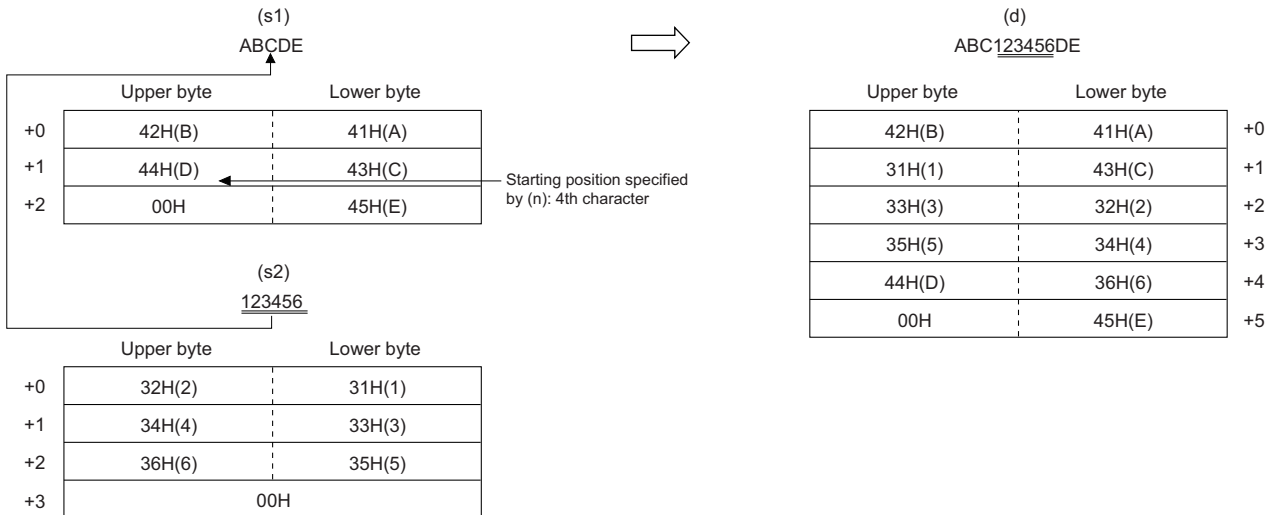
## Processing details

### ■Operation processing

- These functions insert the string input to (s2) into the insertion start position, i.e. the 'n'th character position from the beginning of the string input to (s1), and output the operation result from (d).
- After the (s2) string is inserted into the (s1) string, 00H, which indicates the end of the (s2) string, is ignored.
- If the string after insertion exceeds 255 bytes, the substring up to the 255th byte will be output.

**Ex.**

When (n)=4



- Input a STRING data type value to (s1) and (s2) within the range of 0 to 255 bytes.
- Input an INT data type value to (n) within the range of 1 to 255, provided that it is within the number of characters in the string input to (s1).

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

| Error code (SD0) | Description                                                                                                                                                                                                                                                           |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | From the device numbers specified by (s1) through (s28) onward, there is no NULL code (00H) in each setting area of the device/label memory.<br>There is no NULL code (00H) in each setting area in the device/label memory in the device specified by (d) and later. |
| 2821H            | The device numbers are overlapping between (s1) to (s28) and (d).                                                                                                                                                                                                     |
| 3285H            | The number of characters in the strings input to (s1) to (s28) exceeds 16383.<br>The number of characters in the strings input to (s1) to (s28) is 0.<br>The number of characters of the string in the device specified by (d) exceeds 16383.                         |
| 3286H            | From the device numbers specified in (d) onward, the entire string after concatenate processing cannot be stored in each setting area of the device/label memory. (The number of required points is insufficient.)                                                    |

# 38.6 Deleting String Data

## DELETE(\_E)

These functions delete the specified range in a string, and output the operation result.

| Ladder, FBD/LD              |                          | ST                                                                                                                          |
|-----------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| <div>[Without EN/ENO]</div> | <div>[With EN/ENO]</div> | <div>[Without EN/ENO]</div> <pre>d:=DELETE(s,n1,n2);</pre> <div>[With EN/ENO]</div> <pre>d:=DELETE_E(EN,ENO,s,n1,n2);</pre> |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type        |
|----------|-----------------------------------------------------------|-----------------|------------------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL             |
| s (IN)   | Input                                                     | Input variable  | ANYSTRING_SINGLE |
| n1 (L)   | Number of characters to be deleted                        | Input variable  | INT              |
| n2 (P)   | Deletion target character start position                  | Input variable  | INT              |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL             |
| d        | Output                                                    | Output variable | ANYSTRING_SINGLE |



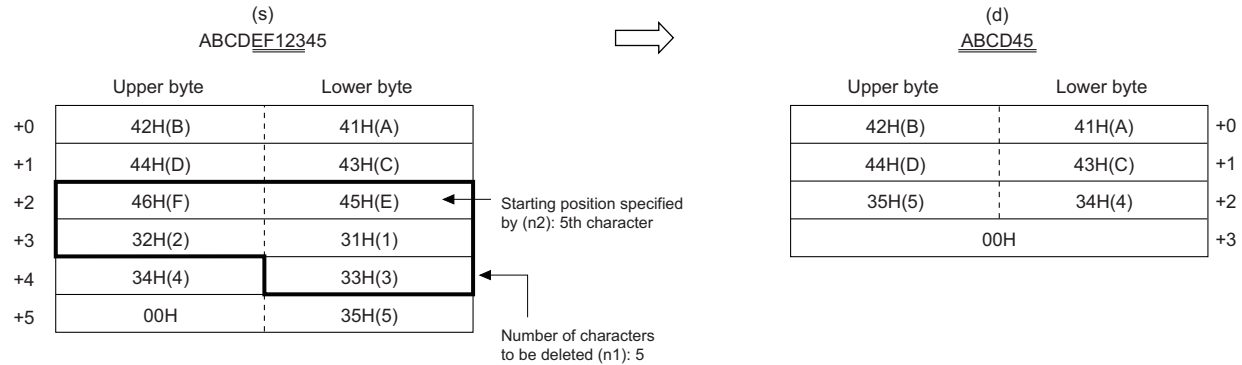
## Processing details

### ■Operation processing

- These functions delete the specified number of characters, starting from the desired position of the string input to (s), and output the remaining substring from (d).
- Specify the number of characters to be deleted in (n1).
- Specify the start position of the string to be deleted in (n2).

**Ex.**

When (n1)=5, (n2)=5



- Input a STRING data type value to (s) within the range of 0 to 255 bytes.
- Input an INT data type value to (n1) within the range of 0 to 255, provided that it is within the number of characters in the string input to (s).
- Input an INT data type value to (n2) within the range of 1 to 255, provided that it is within the number of characters in the string input to (s).

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

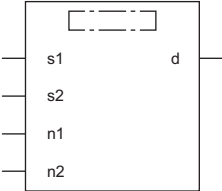
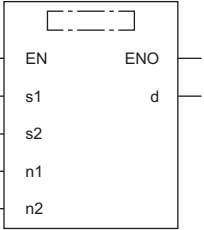
## Operation error

| Error code (SD0) | Description                                                                                                                                                               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the label or device area (between the specified device number and the last device number) specified by (s).                                |
| 3285H            | The number of characters in the string input to (s) exceeds 255.                                                                                                          |
|                  | The value input to (n1) is out of the range, 0 to 255.                                                                                                                    |
|                  | The value input to (n2) is out of the range, 1 to 255.                                                                                                                    |
|                  | The value input to (n1) exceeds the number of characters in (s).                                                                                                          |
|                  | The value input to (n2) exceeds the number of characters in (s).                                                                                                          |
| 3286H            | The entire string after delete processing cannot be stored in the label or device area (between the specified device number and the last device number) specified by (d). |

# 38.7 Replacing String Data

## REPLACE(\_E)

These functions replace the specified range in a string, and output the operation result.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                               |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=REPLACE(s1,s2,n1,n2);<br/>[With EN/ENO]<br/>d:=REPLACE_E(EN,ENO,s1,s2,n1,n2);</div> |
|  |  |                                                                                                                  |

### Setting data

#### ■Description, type, data type

| Argument           | Description                                               | Type            | Data type        |
|--------------------|-----------------------------------------------------------|-----------------|------------------|
| EN                 | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL             |
| s1 (IN1), s2 (IN2) | Input                                                     | Input variable  | ANYSTRING_SINGLE |
| n1 (L)             | Number of characters to be replaced                       | Input variable  | INT              |
| n2 (P)             | Replacement target character start position               | Input variable  | INT              |
| ENO                | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL             |
| d                  | Output                                                    | Output variable | ANYSTRING_SINGLE |

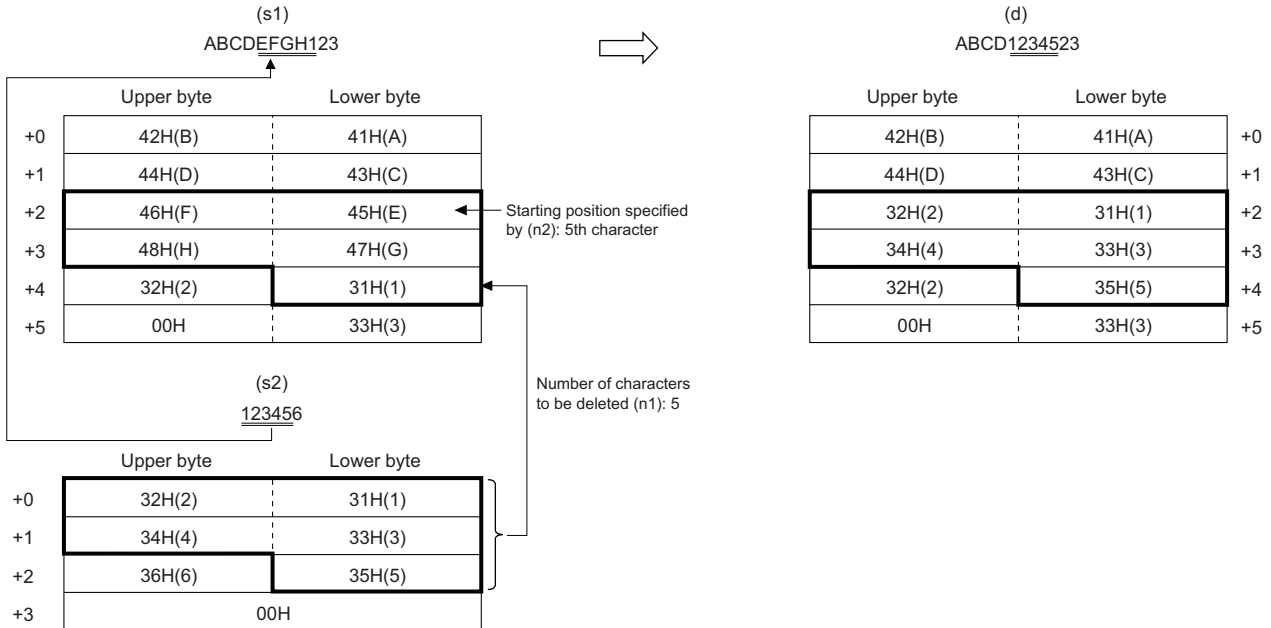
## Processing details

### Operation processing

- These functions replace the specified number of characters starting from the desired position of the string input to (s1) with the string input to (s2), and output the operation result from (d).
- Specify the number of characters to be replaced in (n1).
- Specify the start position of the string to be replaced in (n2).

**Ex.**

When (n1)=5, (n2)=5



- Input a STRING data type value to (s1) and (s2) within the range of 0 to 255 bytes.
- Input an INT data type value to (n1) within the range of 0 to 255, provided that it is within the number of characters in the string input to (s1).
- Input an INT data type value to (n2) within the range of 1 to 255, provided that it is within the number of characters in the string input to (s1).

### Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

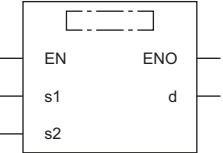
## Operation error

| Error code (SD0) | Description                                                                                                                                                               |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | There is no NULL code (00H) in the label or device area (between the specified device number and the last device number) specified by (s1).                               |
|                  | There is no NULL code (00H) in the label or device area (between the specified device number and the last device number) specified by (s2).                               |
| 3285H            | The number of characters in the string input to (s1) exceeds 255.                                                                                                         |
|                  | The number of characters in the string input to (s2) exceeds 255.                                                                                                         |
|                  | The value input to (n1) is out of the range, 0 to 255.                                                                                                                    |
|                  | The value input to (n2) is out of the range, 1 to 255.                                                                                                                    |
|                  | The value input to (n1) exceeds the number of characters in (s2).                                                                                                         |
|                  | The value input to (n2) exceeds the number of characters in (s1).                                                                                                         |
| 3286H            | The entire string after delete processing cannot be stored in the label or device area (between the specified device number and the last device number) specified by (d). |

# 38.8 Searching String Data

## FIND(\_E)

These functions search a string, and output the operation result.

| Ladder, FBD/LD                                                                                        |                                                                                                    | ST                                                                               |
|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| [Without EN/ENO]<br> | [With EN/ENO]<br> | [Without EN/ENO]<br>d:=FIND(s1,s2);<br>[With EN/ENO]<br>d:=FIND_E(EN,ENO,s1,s2); |

### Setting data

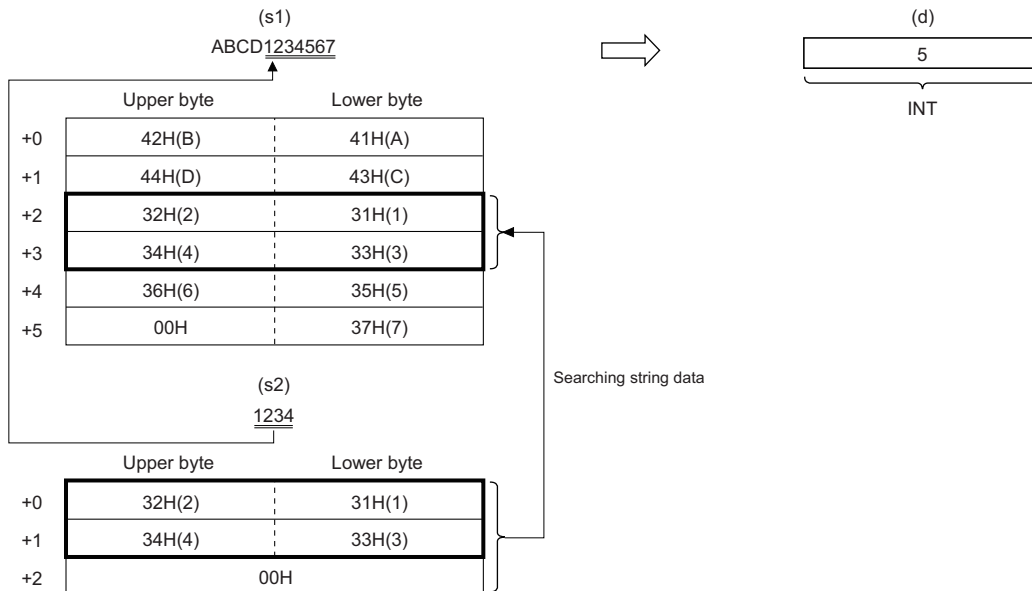
#### ■Description, type, data type

| Argument           | Description                                               | Type            | Data type        |
|--------------------|-----------------------------------------------------------|-----------------|------------------|
| EN                 | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL             |
| s1 (IN1), s2 (IN2) | Input                                                     | Input variable  | ANYSTRING_SINGLE |
| ENO                | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL             |
| d                  | Output                                                    | Output variable | INT              |

## Processing details

### ■Operation processing

- These functions search the string input to (s2) from the beginning of the string input to (s1), and output the search result from (d).
- The start character position of the first string found is output as the search result.
- If the (s2) string is not found in the (s1) string, 0 will be output.



- Input a STRING data type value to (s1) and (s2) within the range of 0 to 255 bytes.

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

\*1 If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

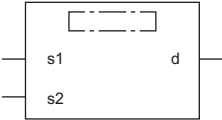
| Error code (SD0) | Description                                                                                                                    |
|------------------|--------------------------------------------------------------------------------------------------------------------------------|
| 2820H            | From the device numbers specified in (s1) onward, there is no NULL code (00H) in each setting area of the device/label memory. |
|                  | From the device numbers specified in (s2) onward, there is no NULL code (00H) in each setting area of the device/label memory. |
| 3285H            | The number of characters in the string input to (s1) exceeds 16383.                                                            |
|                  | The number of characters in the string input to (s1) is 0.                                                                     |
|                  | The number of characters in the string input to (s2) exceeds 16383.                                                            |
|                  | The number of characters in the string input to (s2) is 0.                                                                     |

# 39 TIME DATA TYPE FUNCTIONS

## 39.1 Addition

### ADD\_TIME(\_E)

These functions output the sum ((s1)+(s2)) of the TIME data type input values.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=ADD_TIME(s1,s2);<br/>[With EN/ENO]<br/>d:=ADD_TIME_E(EN,ENO,s1,s2);</div> |
|  |  |                                                                                                        |

### Setting data

#### ■Description, type, data type

| Argument           | Description                                               | Type            | Data type |
|--------------------|-----------------------------------------------------------|-----------------|-----------|
| EN                 | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (IN1), s2 (IN2) | Input                                                     | Input variable  | TIME      |
| ENO                | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d                  | Output                                                    | Output variable | TIME      |

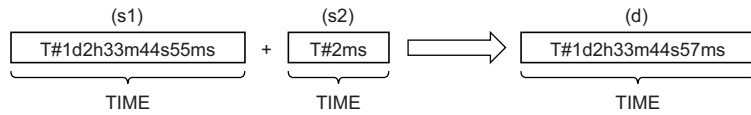
## Processing details

### ■Operation processing

- These functions perform addition of the TIME data type values input to (s1) and (s2) ((s1)+(s2)), and output the operation result, in the TIME data type, from (d).

**Ex.**

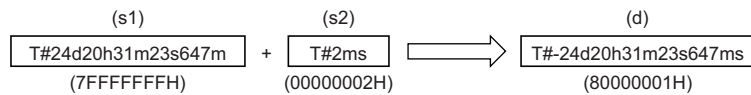
When (s1)=T#1d2h33m44s55ms (1 day, 2 hours, 33 minutes, 44 seconds, 55 milliseconds) and (s2)=T#2ms (2 milliseconds)



- Input a TIME data type value to (s1) and (s2).
- Even if an underflow or overflow occurs in the operation result, no operation error is issued. The following is output to (d).  
When ADD\_TIME\_E is used, ENO outputs TRUE.

**Ex.**

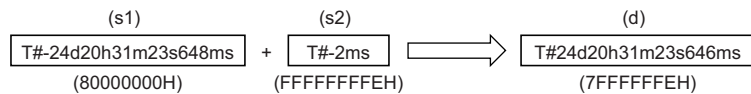
Overflow



A negative time value results because the most significant bit is 1.

**Ex.**

Underflow



A positive time value results because the most significant bit is 0.

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

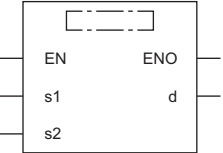
There is no operation error.



# 39.2 Subtraction

## SUB\_TIME(\_E)

These functions output the difference ((s1)-(s2)) between the TIME data type input values.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=SUB_TIME(s1,s2);<br/>[With EN/ENO]<br/>d:=SUB_TIME_E(EN,ENO,s1,s2);</div> |
|  |  |                                                                                                        |

### Setting data

#### ■Description, type, data type

| Argument           | Description                                               | Type            | Data type |
|--------------------|-----------------------------------------------------------|-----------------|-----------|
| EN                 | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (IN1), s2 (IN2) | Input                                                     | Input variable  | TIME      |
| ENO                | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d                  | Output                                                    | Output variable | TIME      |

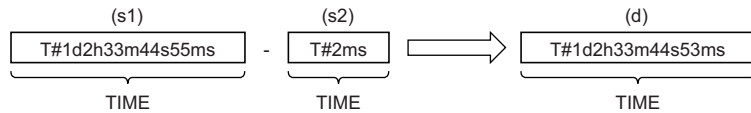
## Processing details

### ■Operation processing

- These functions perform subtraction between the TIME data type values input to (s1) and (s2) ((s1)-(s2)), and output the operation result, in the TIME data type, from (d).

**Ex.**

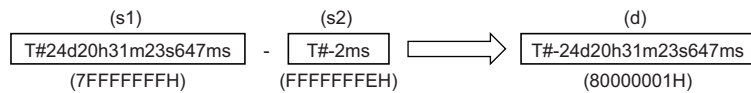
When (s1)=T#1d2h33m44s55ms (1 day, 2 hours, 33 minutes, 44 seconds, 55 milliseconds) and (s2)=T#2ms (2 milliseconds)



- Input a TIME data type value to (s1) and (s2).
- Even if an underflow or overflow occurs in the operation result, no operation error is issued. The following is output to (d).  
When SUB\_TIME\_E is used, ENO outputs TRUE.

**Ex.**

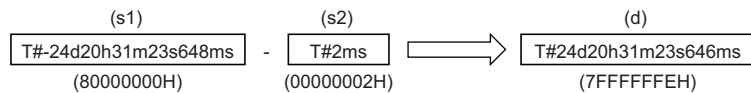
Overflow



A negative time value results because the most significant bit is 1.

**Ex.**

Underflow



A positive time value results because the most significant bit is 0.

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

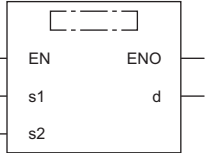
## Operation error

There is no operation error.

# 39.3 Multiplication

## MUL\_TIME(\_E)

These functions output the product ((s1)×(s2)) of the TIME data type input values.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>d:=MUL_TIME(s1,s2);<br>[With EN/ENO]<br>d:=MUL_TIME_E(EN,ENO,s1,s2); |
|  |  |                                                                                          |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (IN1) | Input                                                     | Input variable  | TIME      |
| s2 (IN2) | Input                                                     | Input variable  | ANY_NUM   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | TIME      |

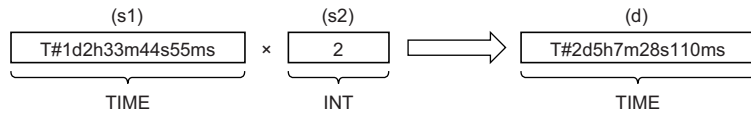
## Processing details

### ■Operation processing

- These functions perform multiplication between the TIME data type values input to (s1) and (s2) ((s1)×(s2)), and output the operation result, in the TIME data type, from (d).

**Ex.**

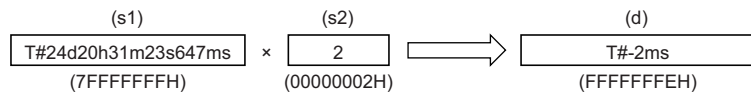
When (s1)=T#1d2h33m44s55ms (1 day, 2 hours, 33 minutes, 44 seconds, 55 milliseconds) and (s2)=2



- Input a TIME data type value to (s1).
- Input an INT, DINT, REAL, or LREAL data type value to (s2).
- Even if an underflow or overflow occurs in the operation result, no operation error is issued. The following is output to (d).  
 When MUL\_TIME\_E is used, ENO outputs TRUE. (In this case, the output value is of TIME data type with the upper 32 bits deleted although the operation result is 64-bit data.)

**Ex.**

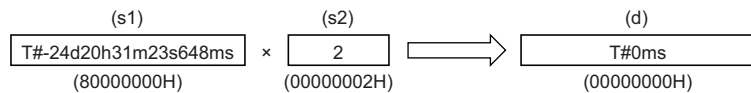
Overflow



A negative time value results because the most significant bit is 1.

**Ex.**

Underflow



A positive time value results because the most significant bit is 0.

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

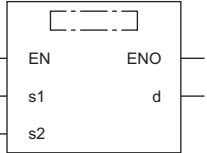
- When (s2) is of LREAL data type

| Error code (SD0) | Description                                                                                                                                                                                                                                                                                                                                         |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3282H            | The value input to (s2) is out of the following range:<br>$-2^{1024} < (s2) \leq -2^{1022}$ , $0$ , $2^{-1022} \leq (s2) < 2^{1024}$<br>(E-1.7976931348623157+308 to E-2.2250738585072014-308, $0$ , E2.2250738585072014-308 to E1.7976931348623157+308)<br>The value input to (s2) is -0, a subnormal number, NaN (not a number), or $\pm\infty$ . |
| 3285H            | The single-precision real number input to (s2) is out of the range, -2147483648 to 2147483647.                                                                                                                                                                                                                                                      |

# 39.4 Division

## DIV\_TIME(\_E)

These functions output the quotient ((s1)÷(s2)) of the TIME data type input values.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>d:=DIV_TIME(s1,s2);<br/>[With EN/ENO]<br/>d:=DIV_TIME_E(EN,ENO,s1,s2);</div> |
|  |  |                                                                                                        |

### Setting data

#### ■Description, type, data type

| Argument | Description                                               | Type            | Data type |
|----------|-----------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s1 (IN1) | Input                                                     | Input variable  | TIME      |
| s2 (IN2) | Input                                                     | Input variable  | ANY_NUM   |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal)             | Output variable | BOOL      |
| d        | Output                                                    | Output variable | TIME      |

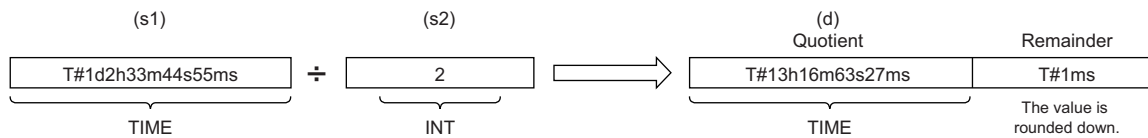
## Processing details

### ■Operation processing

- These functions perform division between the TIME data type values input to (s1) and (s2) ((s1)÷(s2)), and output the operation result, in the TIME data type, from (d). The remainder is rounded down.

**Ex.**

When (s1)=T#1d2h33m44s55ms (1 day, 2 hours, 33 minutes, 44 seconds, 55 milliseconds) and (s2)=2



- Input a TIME data type value to (s1).
- Input an INT, DINT, REAL, or LREAL data type value to (s2). (Note that the value input to (s2) shall be other than 0.)

### ■Operation result

#### 1. Function without EN/ENO

The operation processing is performed. The operation result is output from (d).

#### 2. Function with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result    |                               |
|----------------------|---------------------|-------------------------------|
| EN                   | ENO                 | (d)                           |
| TRUE (executed)      | TRUE                | Operation result output value |
| FALSE (not executed) | FALSE <sup>*1</sup> | Undefined value               |

<sup>\*1</sup> If the value FALSE is output from ENO, the output data from (d) will be undefined. Create a program so that the undefined value will not be used in operations.

## Operation error

| Error code (SD0)                  | Description                                                                                                                                                                                                                                            |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3280H                             | The value input to (s2) is 0. (The value is divided by zero.)                                                                                                                                                                                          |
| • When (s2) is of LREAL data type |                                                                                                                                                                                                                                                        |
| 3282H                             | The value input to (s2) is out of the following range:<br>$-2^{1024} < (s2) \leq -2^{-1022}$ , $0$ , $2^{-1022} \leq (s2) < 2^{1024}$<br>(E-1.7976931348623157+308 to E-2.2250738585072014-308, 0, E2.2250738585072014-308 to E1.7976931348623157+308) |
| 3285H                             | The data input to (s2) is out of the range, -2147483648 to 2147483647.                                                                                                                                                                                 |

This part consists of the following chapters.

---

40 BISTABLE FUNCTION BLOCKS

---

41 EDGE DETECTION FUNCTION BLOCKS

---

42 COUNTER/TIMER FUNCTION BLOCKS

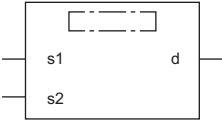
---

# 40 BISTABLE FUNCTION BLOCKS

## 40.1 Bistable Function Block (Set-dominant)

### SR(\_E)

These function blocks discriminate between two input values, and output 1 (TRUE) or 0 (FALSE).

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                                                          |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>Instance name(S1:=s1,R:=s2,Q1:=d);<br/>[With EN/ENO]<br/>Instance name(EN:=en,ENO:=eno,S1:=s1,R:=s2,Q1:=d);</div> |
|  |  |                                                                                                                                             |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s1 (S1)  | Set command                                                     | Input variable  | BOOL      |
| s2 (R)   | Reset command                                                   | Input variable  | BOOL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d (Q1)   | Output                                                          | Output variable | BOOL      |



## Processing details

### ■ Operation processing

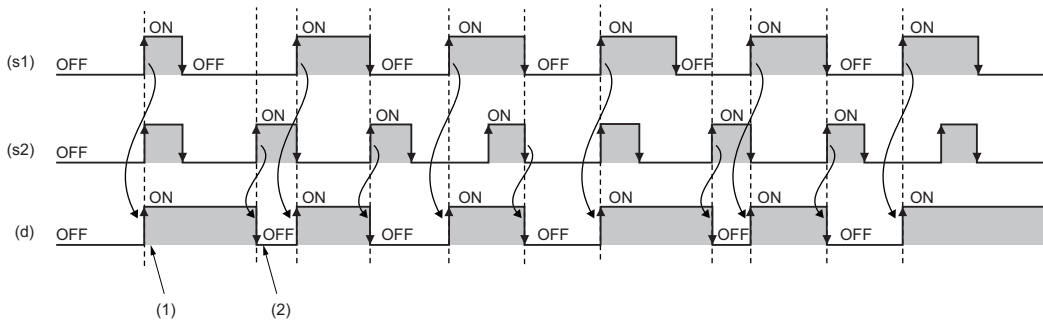
- When (s1) turns on, (d) is set. Turning on (s2) while (s1) is off resets (d).
- Even when (s2) turns on while (s1) is on, (d) is not reset.

### ■ Operation result

#### 1. Function block without EN/ENO

The operation processing is performed. The operation result is output from (d).

- Timing chart



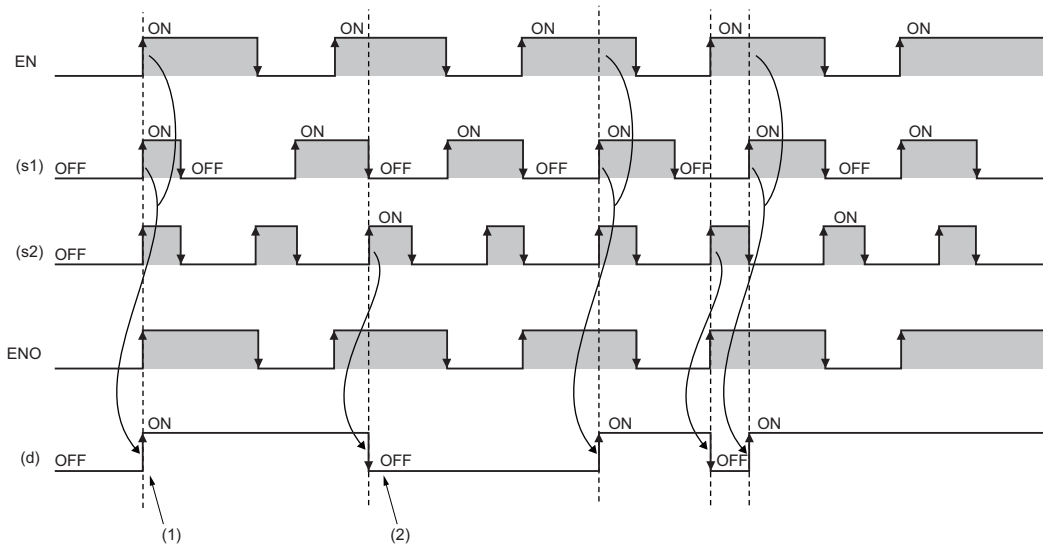
- (1) When (s1) turns on, (d) turns on.  
 (2) When (s2) turns on while (s1) is off, (d) turns off.

#### 2. Function block with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE            | Previous output value         |

- Timing chart



- (1) When (s1) turns on while EN is on, (d) turns on.  
 (2) When (s2) turns on while EN is on and (s1) is off, (d) turns off.

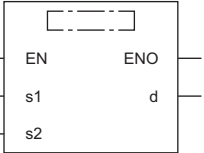
## Operation error

There is no operation error.

# 40.2 Bistable Function Block (Reset-dominant)

## RS(\_E)

These function blocks discriminate between two input values, and output 1 (TRUE) or 0 (FALSE).

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                                            |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>Instance name(S:=s1,R1:=s2,Q1:=d);<br>[With EN/ENO]<br>Instance name(EN:=en,ENO:=eno,S:=s1,R1:=s2,Q1:=d); |
|  |  |                                                                                                                               |

## Setting data

### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s1 (S)   | Set command                                                     | Input variable  | BOOL      |
| s2 (R1)  | Reset command                                                   | Input variable  | BOOL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d (Q1)   | Output                                                          | Output variable | BOOL      |

## Processing details

### ■ Operation processing

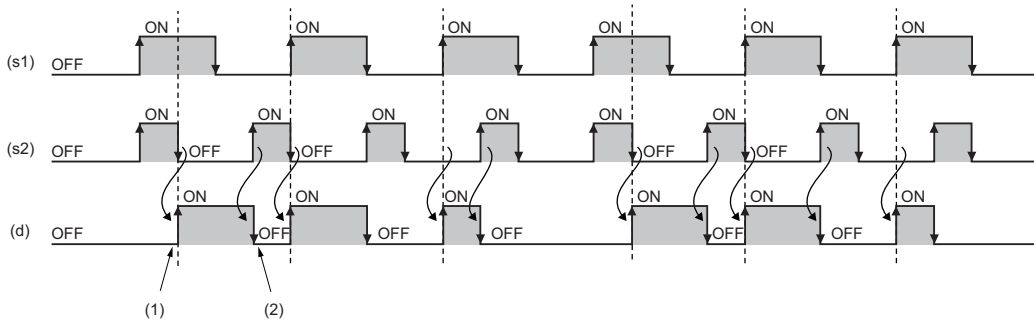
- When (s1) turns on, (d) is set. When (s2) turns on, (d) is reset.
- Even when (s1) turns on while (s2) is on, (d) is not set.

### ■ Operation result

#### 1. Function block without EN/ENO

The operation processing is performed. The operation result is output from (d).

- Timing chart



(1) When (s2) turns off while (s1) is on, (d) turns on.

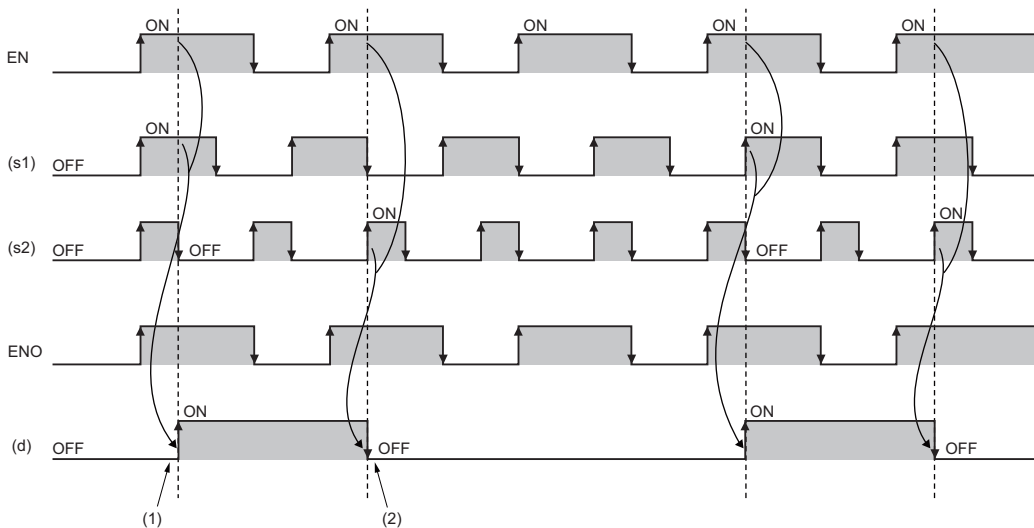
(2) When (s2) turns on, (d) turns off.

#### 2. Function block with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE            | Previous output value         |

- Timing chart



(1) When (s2) turns off while EN is on and (s1) is on, (d) turns on.

(2) When (s2) turns on while EN is on, (d) turns off.

## Operation error

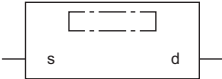
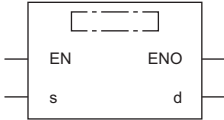
There is no operation error.

# 41 EDGE DETECTION FUNCTION BLOCKS

## 41.1 Detecting a Rising Edge

### R\_TRIG(\_E)

These function blocks detect a signal rising edge, and outputs the pulse signal.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                                            |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>Instance name(CLK:=s,Q:=d);<br/>[With EN/ENO]<br/>Instance name(EN:=en,ENO:=eno,CLK:=s,Q:=d);</div> |
|  |  |                                                                                                                               |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s (CLK)  | Rising edge detection input                                     | Input variable  | BOOL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d (Q)    | Output                                                          | Output variable | BOOL      |

## Processing details

### ■ Operation processing

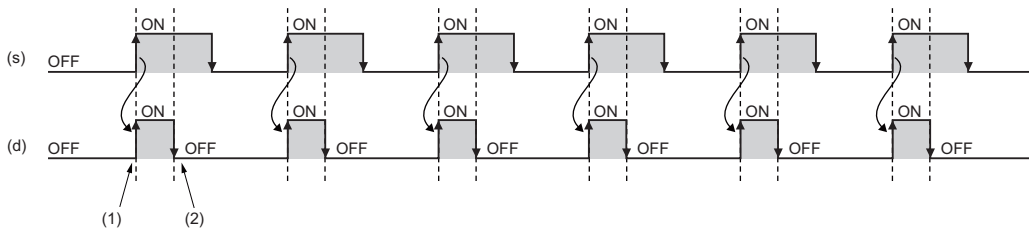
When (s) turns on, (d) turns on only for one scan.

### ■ Operation result

#### 1. Function block without EN/ENO

The operation processing is performed. The operation result is output from (d).

- Timing chart



(1) (d) turns on at the rising edge of (s).

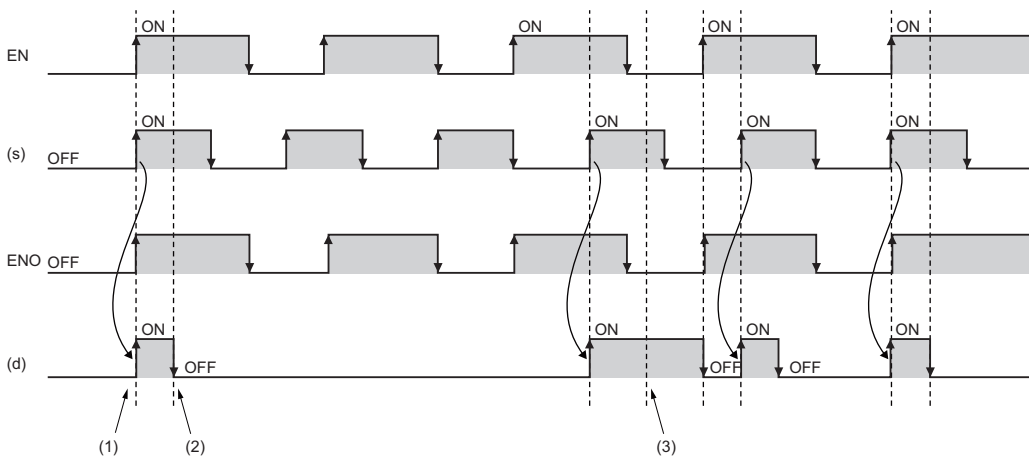
(2) (d) turns off in the next scan.

#### 2. Function block with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE            | Previous output value         |

- Timing chart



(1) (d) turns on at the rising edge of (s) while EN is on.

(2) (d) turns off in the next scan.

(3) If EN is off, (d) holds the output value of the last scan.

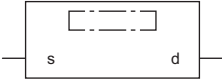
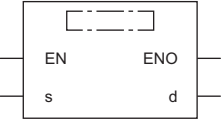
## Operation error

There is no operation error.

# 41.2 Detecting a Falling Edge

## F\_TRIG(\_E)

These function blocks detect a signal falling edge, and outputs the pulse signal.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                               |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>Instance name(CLK:=s,Q:=d);<br>[With EN/ENO]<br>Instance name(EN:= en,ENO:=eno,CLK:=s,Q:=d); |
|  |  |                                                                                                                  |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s (CLK)  | Falling edge detection input                                    | Input variable  | BOOL      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d (Q)    | Output                                                          | Output variable | BOOL      |

## Processing details

### ■ Operation processing

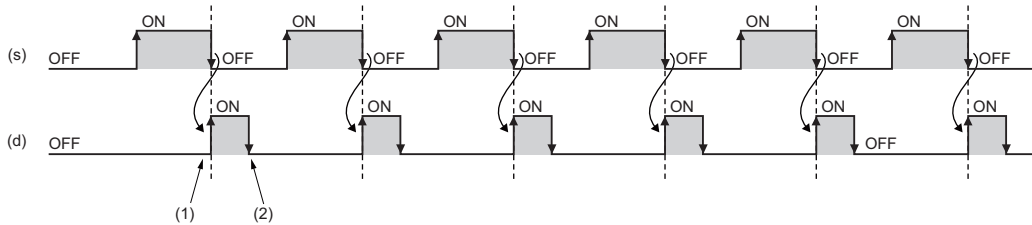
When (s) turns off, (d) turns on only for one scan.

### ■ Operation result

#### 1. Function block without EN/ENO

The operation processing is performed. The operation result is output from (d).

- Timing chart



(1) (d) turns on at the falling edge of (s).

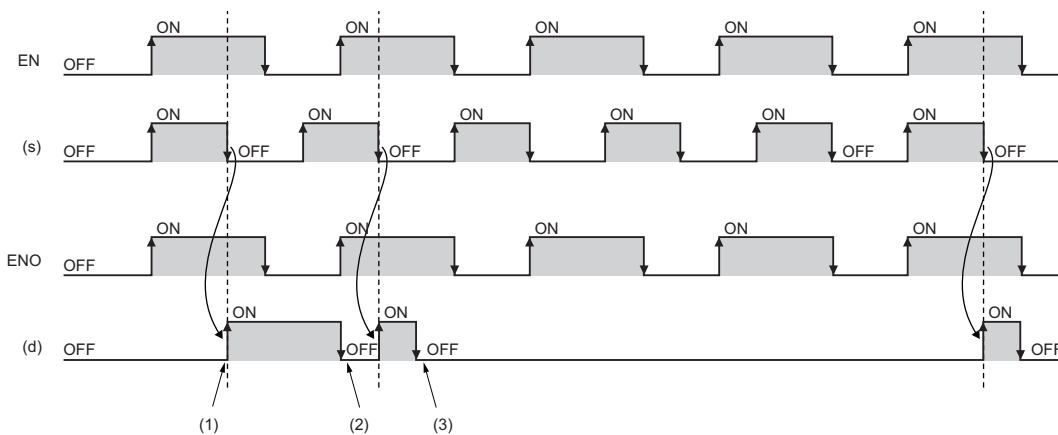
(2) (d) turns off in the next scan.

#### 2. Function block with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d)                           |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE            | Previous output value         |

- Timing chart



(1) (d) turns on at the falling edge of (s) while EN is on.

(2) (d) turns off in the next scan.

(3) If EN is off, (d) holds the output value of the last scan.

## Operation error

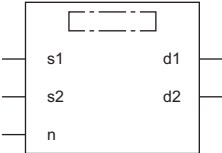
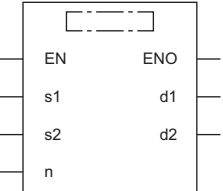
There is no operation error.

# 42 COUNTER/TIMER FUNCTION BLOCKS

## 42.1 Up Counter

### CTU(\_E)

These function blocks count up the number of rising edges of a signal.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                                                                                    |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | <div>[Without EN/ENO]<br/>Instance name(CU:=s1,R:=s2,PV:=n,Q:=d1,CV:=d2);<br/>[With EN/ENO]<br/>Instance name(EN:=en,ENO:=eno,CU:=s1,R:=s2,PV:=n,Q:=d1,CV:=d2);</div> |
|  |  |                                                                                                                                                                       |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s1 (CU)  | Count signal input                                              | Input variable  | BOOL      |
| s2 (R)   | Count value reset                                               | Input variable  | BOOL      |
| n (PV)   | Maximum count value                                             | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d1 (Q)   | End of count                                                    | Output variable | BOOL      |
| d2 (CV)  | Count value                                                     | Output variable | INT       |

### Processing details

#### ■Operation processing

##### 1. Counting up

- When (s1) changes from off to on, the value in (d2) is counted up by one.
- When (d2) reaches the (n) value, (d1) turns on and the counting stops.
- Set the maximum counter value to (n). When (s2) turns on, (d1) turns off and (d2) is set to 0.

##### 2. Maximum count value

The valid setting range of (n) is 0 to 32767.



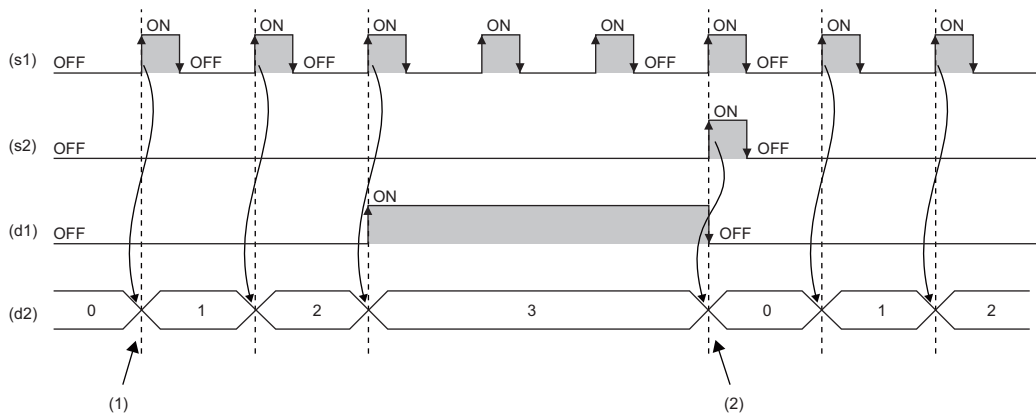
## ■Operation result

## 1. Function block without EN/ENO

The operation processing is performed. The operation result is output from (d1) and (d2).

- Timing chart

When  $(n)=3$



- (1) When (s1) turns on, the value in (d2) is counted up.
- (2) When (s2) turns on, the value in (d2) is initialized.

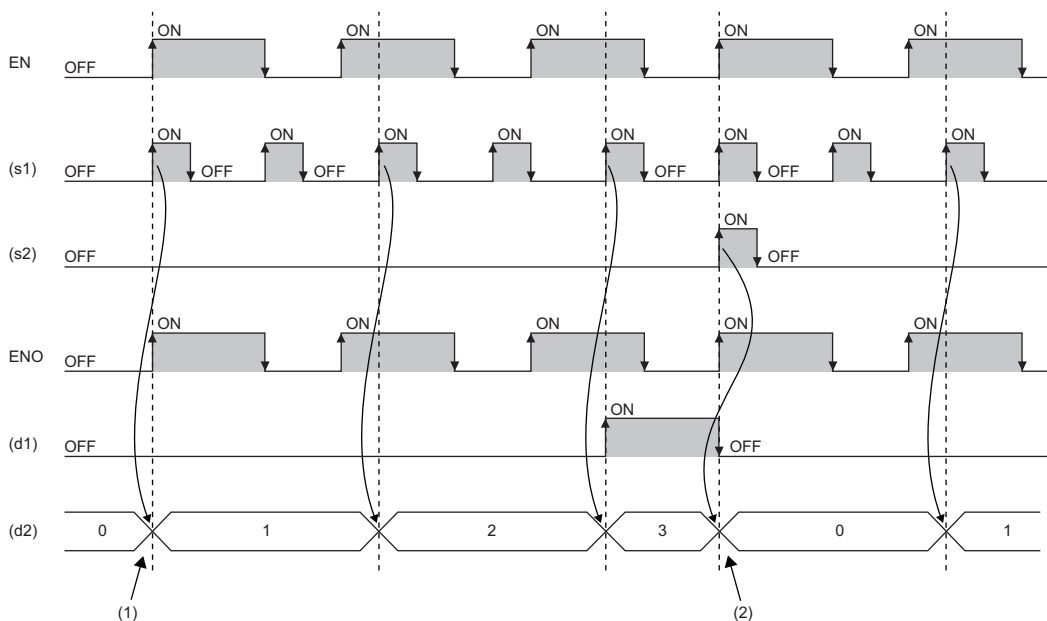
## 2. Function block with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d1), (d2)                    |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE            | Previous output value         |

- Timing chart

When  $(n)=3$



- (1) When (s1) turns on while EN is on, the value in (d2) is counted up.
- (2) When (s2) turns on while EN is on, the value in (d2) is initialized.

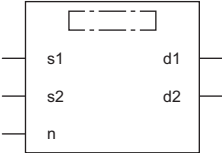
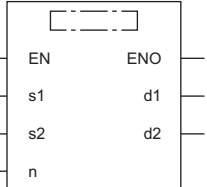
## Operation error

There is no operation error.

## 42.2 Down Counter

### CTD(\_E)

These function blocks count down the number of rising edges of a signal.

| Ladder, FBD/LD                                                                    |                                                                                   | ST                                                                                                                                                        |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO]                                                                  | [With EN/ENO]                                                                     | [Without EN/ENO]<br>Instance name(CD:=s1,LD:=s2,PV:=n,Q:=d1,CV:=d2);<br>[With EN/ENO]<br>Instance name(EN:=en,ENO:=eno,CD:=s1,LD:=s2,PV:=n,Q:=d1,CV:=d2); |
|  |  |                                                                                                                                                           |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s1(CD)   | Count signal input                                              | Input variable  | BOOL      |
| s2 (LD)  | Count value set                                                 | Input variable  | BOOL      |
| n (PV)   | Start count value                                               | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d1 (Q)   | End of count                                                    | Output variable | BOOL      |
| d2 (CV)  | Count value                                                     | Output variable | INT       |

### Processing details

#### ■Operation processing

##### 1. Counting down

- When (s1) changes from off to on, the value in (d2) is counted down by one.
- When (d2) is 0, (d1) turns on and the counting stops.
- Set the start count value to (n). When (s2) turns on, (d1) turns off and (n) is set to (d2).

##### 2. Start count value

The valid setting range of (n) is 0 to 32767.

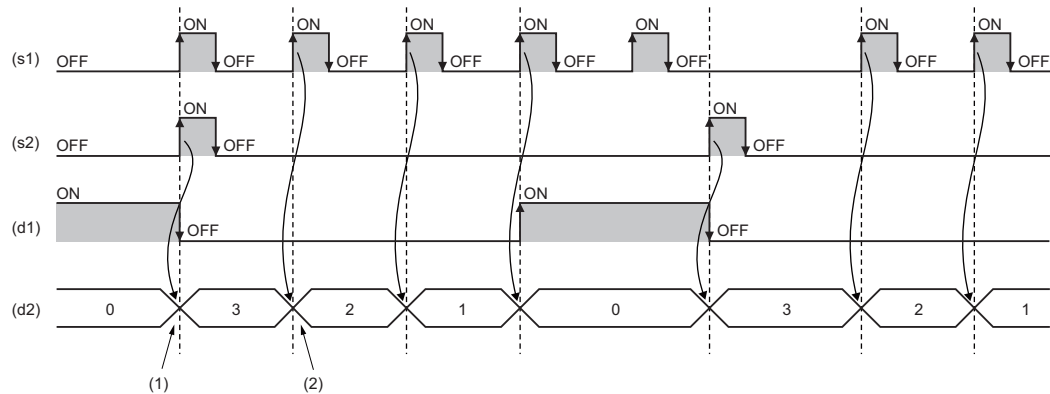
## ■ Operation result

### 1. Function block without EN/ENO

The operation processing is performed. The operation result is output from (d1) and (d2).

- Timing chart

When (n)=3



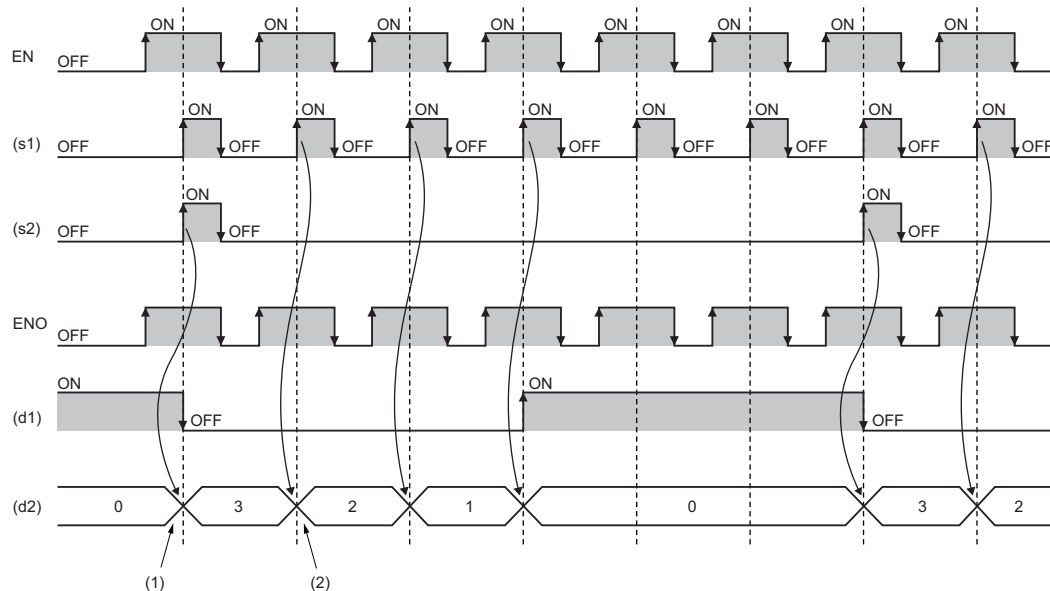
### 2. Function block with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d1), (d2)                    |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE            | Previous output value         |

- Timing chart

When (n)=3



## Operation error

There is no operation error.

## 42.3 Up/Down Counter

### CTUD(\_E)

These function blocks count up or down the number of rising edges of a signal.

| Ladder, FBD/LD   |               | ST                                                                                                                                                                                                        |
|------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>Instance<br>name(CU:=s1,CD:=s2,R:=s3,LD:=s4,PV:=n,QU:=d1,QD:=d2,CV:=d3);<br>[With EN/ENO]<br>Instance<br>name(EN:=en,ENO:=eno,CU:=s1,CD:=s2,R:=s3,LD:=s4,PV:=n,QU:=d1,QD:=d2,CV:=d3); |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s1 (CU)  | Count signal input (for counting-up)                            | Input variable  | BOOL      |
| s2 (CD)  | Count signal input (for counting-down)                          | Input variable  | BOOL      |
| s3 (R)   | Count value reset                                               | Input variable  | BOOL      |
| s4 (LD)  | Count value set                                                 | Input variable  | BOOL      |
| n (PV)   | Maximum count value or start count value                        | Input variable  | INT       |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d1 (QU)  | End of count (for counting-up)                                  | Output variable | BOOL      |
| d2 (QD)  | End of count (for counting-down)                                | Output variable | BOOL      |
| d3 (CV)  | Current count value                                             | Output variable | INT       |

## Processing details

### ■ Operation processing

In (n), set the maximum count value for up count and the start count value for down count. The valid range of (n) is 0 to 32767.

#### 1. Counting up

- When (s1) changes from off to on, the value in (d3) is counted up by one.
- When (d3) reaches the (n) value, (d1) turns on and the counting stops.
- When (s3) turns on, (d1) turns off and (d3) is set to 0.

#### 2. Counting down

- When (s2) changes from off to on, the value in (d3) is counted down by one.
- When (d3) is 0, (d2) turns on and the counting stops.
- When (s4) turns on, (d2) turns off and (n) is set to (d3).

#### 3. Others

- When (s1) and (s2) change from off to on simultaneously, the value in (d3) is counted up by one with priority given to (s1).
- When (s3) and (s4) turn on simultaneously, (d3) is set to 0 with priority given to (s3).

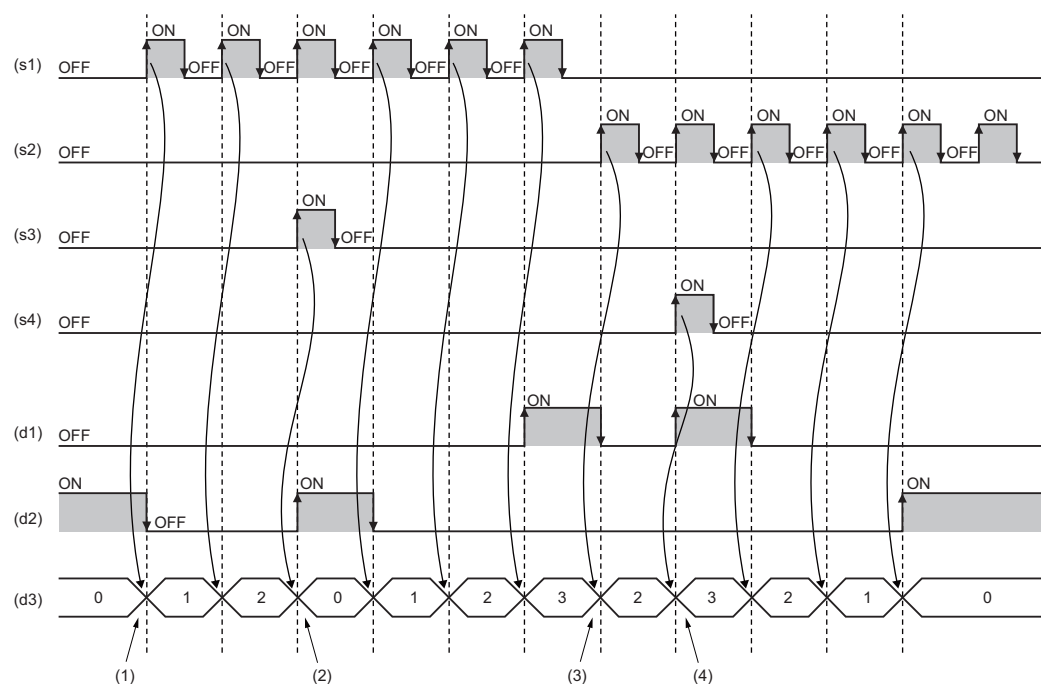
### ■ Operation result

#### 1. Function block without EN/ENO

The operation processing is performed. The operation result is output from (d1), (d2), and (d3).

- Timing chart

When (n)=3



- (1) When (s1) turns on, the value in (d3) is counted up.
- (2) When (s3) turns on, the value in (d3) is initialized.
- (3) When (s2) turns on, the value in (d3) is counted down.
- (4) When (s4) turns on, the value in (d3) is initialized.

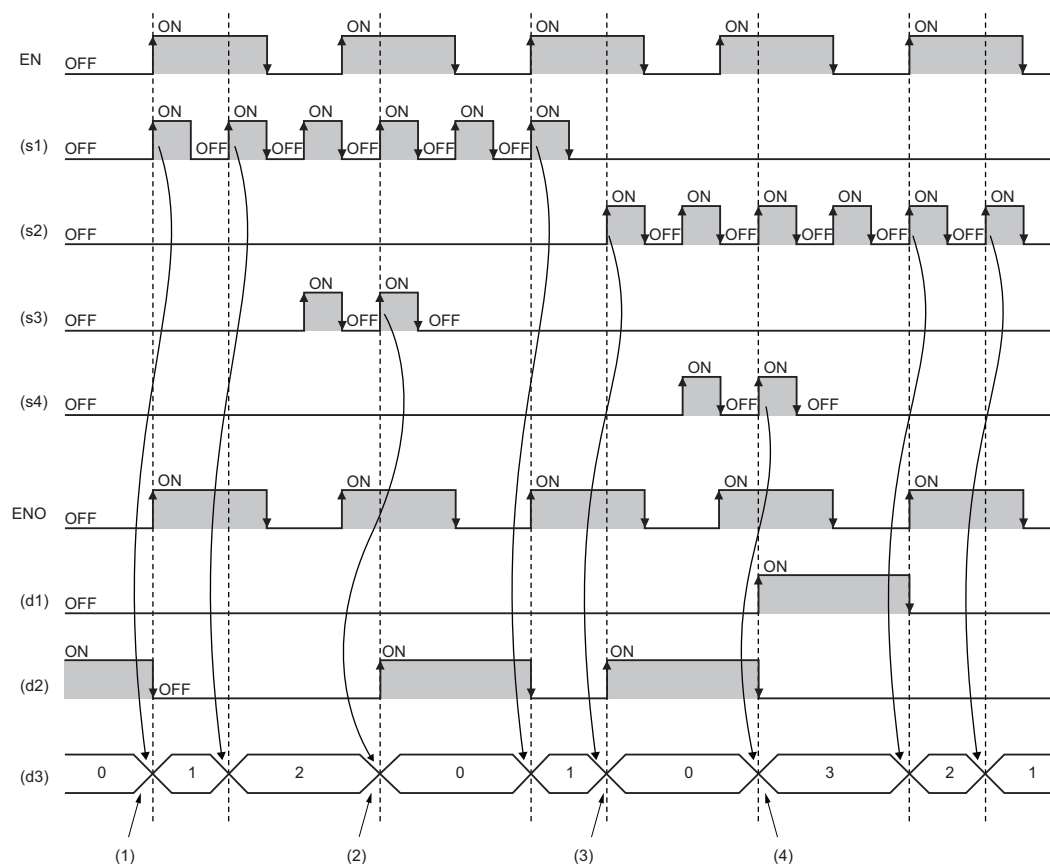
## 2. Function block with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result |                               |
|----------------------|------------------|-------------------------------|
| EN                   | ENO              | (d1), (d2), (d3)              |
| TRUE (executed)      | TRUE             | Operation result output value |
| FALSE (not executed) | FALSE            | Previous output value         |

### • Timing chart

When (n)=3



- (1) When (s1) turns on while EN is on, the value in (d3) is counted up.
- (2) When (s3) turns on while EN is on, the value in (d3) is initialized.
- (3) When (s2) turns on while EN is on, the value in (d3) is counted down.
- (4) When (s4) turns on while EN is on, the value in (d3) is initialized.

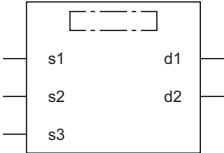
### Operation error

There is no operation error.

# 42.4 Counter Function Block

## COUNTER\_FB\_M

This function block starts counting up when the execution condition is satisfied.

| Ladder, FBD/LD                                                                    | ST                                                                      |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------|
|  | Instance name(Coil:=s1,Preset:=s2,ValueIn:=s3,ValueOut:=d1,Status:=d2); |

### Setting data

#### ■Description, type, data type

| Argument      | Description                                               | Type            | Data type |
|---------------|-----------------------------------------------------------|-----------------|-----------|
| s1 (Coil)     | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s2 (Preset)   | Counter setting value                                     | Input variable  | INT       |
| s3 (ValueIn)  | Initial counter value                                     | Input variable  | INT       |
| d1 (ValueOut) | Current counter value                                     | Output variable | ANY16     |
| d2 (Status)   | Output                                                    | Output variable | BOOL      |

## Processing details

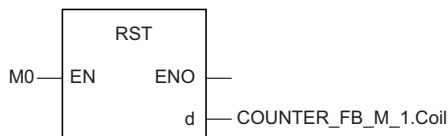
### ■ Operation processing

- The number of rising edges (status changes (off to on)) of (s1) is counted. Counting is not performed while (s1) remains on. The counting starts from the (s3) value. When it reached the (s2) value, (d2) turns on. The current value is stored in (d1).
- The valid setting range of (s2) is 0 to 32767.
- The valid setting range of (s3) is -32768 to 32767. Note that if a negative value is specified, 0 will be used as the initial value.
- To reset the current value (d1), reset (s1) of FB directly.

**Ex.**

Label name: COUNTER\_FB\_M\_1

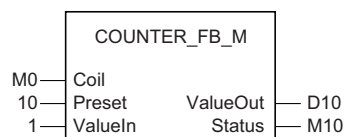
[Ladder program]



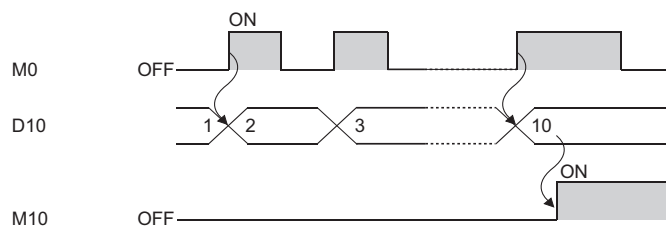
[ST program]

RST(M0, COUNTER\_FB\_M\_1.Coil)

[Ladder example]



[Timing chart]



## Operation error

There is no operation error.



## 42.5 Pulse Timer

42

### TP(\_E)

These function blocks keep the signal on for the specified period of time.

| Ladder, FBD/LD   |               | ST                                                                                                                                        |
|------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>Instance name(IN:=s,PT:=n,Q:=d1,ET:=d2);<br>[With EN/ENO]<br>Instance name(EN:=en,ENO:=eno,IN:=s,PT:=n,Q:=d1,ET:=d2); |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s (IN)   | Start of output                                                 | Input variable  | BOOL      |
| n (PT)   | Output time setting value                                       | Input variable  | TIME      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d1 (Q)   | Output                                                          | Output variable | BOOL      |
| d2 (ET)  | Elapsed time                                                    | Output variable | TIME      |

### Processing details

#### ■Operation processing

##### 1. Output

- When (s) turns on, (d1) turns on for the period of time set by (n). The time elapsed after (d1) turns on is set to (d2).
- Use the long timer to count the elapsed time.

##### 2. End of output

- Once the elapsed time reaches the setting time, (d1) turns off.
- If (s) is off after (d1) turns off, the elapsed time is reset.
- Even when (s) turns off while (d1) is on, (d1) does not turn off.

##### 3. Output time setting

The valid setting range of (n) is T#1ms to T#2147483ms. Note that the valid setting range will be as follows by changing the timer limit setting using the engineering tool.

| Minimum value                                                                                                                                                               | Maximum value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Identical to the long timer setting value [ms] in the timer limit setting.<br>Note that if the long timer setting value is smaller than 1ms, the minimum value will be 1ms. | The time satisfying the following condition is used.<br>Note that the maximum value is a value that can be included within the range of time type because the output time setting value is of time type (32-bit value). <ul style="list-style-type: none"> <li>Output time setting value [ms] ≤ 2147483647 [ms] × Long timer setting value in the timer limit setting [ms]</li> </ul> [Example] <ul style="list-style-type: none"> <li>If the long timer setting value is 0.001ms: T#1ms to T#2147483ms</li> <li>If the long timer setting value is 1000ms: T#1000ms to T#2147483000ms</li> </ul> |

The value at the rising edge (off to on) of (d1) is used for the setting value of (n). When the (n) value is changed when (d1) is on, the new value will be enabled at the next output start timing.

## ■Operation result

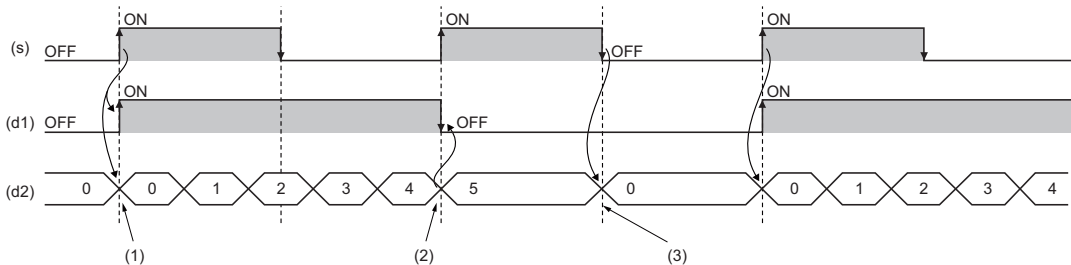
### 1. Function block without EN/ENO

The operation result will be as follows.

| Operation result   | (d1), (d2)                    |
|--------------------|-------------------------------|
| No operation error | Operation result output value |
| Operation error    | Undefined value               |

#### • Timing chart

When  $n=T\#5s$  (5s)



(1) When (s) turns on, (d1) turns on. When (s) turns on, (d2) starts measuring time.

(2) When the time measured in (d2) reaches the time set in (n), (d1) turns off.

(3) When both (s) and (d1) are off, the value in (d2) is initialized.

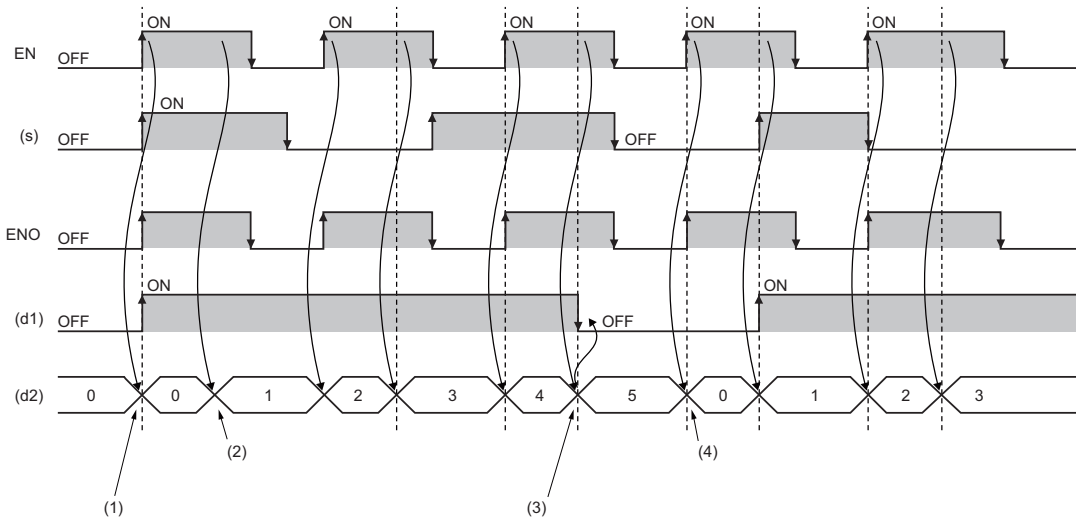
### 2. Function block with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result          |                               |
|----------------------|---------------------------|-------------------------------|
| EN                   | ENO                       | (d1), (d2)                    |
| TRUE (executed)      | TRUE (no operation error) | Operation result output value |
|                      | FALSE (operation error)   | Undefined value               |
| FALSE (not executed) | FALSE                     | Previous output value         |

#### • Timing chart

When  $n=T\#5s$  (5s)



(1) When (s) turns on while EN is on, (d1) turns on. When (s) turns on while EN is on, (d2) starts measuring time.

(2) While EN is on, the time value is incremented by 1.

(3) When the time measured in (d2) reaches the time set in (n), (d1) turns off.

(4) When EN is on and both (s) and (d1) are off, the value in (d2) is initialized.

## Operation error

| Error code (SD0) | Description                                            |
|------------------|--------------------------------------------------------|
| 3281H            | The output time setting value exceeds the valid range. |

42

## 42.6 On Delay Timer

### TON(\_E)

These function blocks turn on a signal after the specified period of time.

| Ladder, FBD/LD   |               | ST                                                                                                                                        |
|------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>Instance name(IN:=s,PT:=n,Q:=d1,ET:=d2);<br>[With EN/ENO]<br>Instance name(EN:=en,ENO:=eno,IN:=s,PT:=n,Q:=d1,ET:=d2); |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s (IN)   | Time measurement                                                | Input variable  | BOOL      |
| n (PT)   | Delay time setting value                                        | Input variable  | TIME      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d1 (Q)   | Output                                                          | Output variable | BOOL      |
| d2 (ET)  | Elapsed time                                                    | Output variable | TIME      |

### Processing details

#### ■Operation processing

##### 1. Output

- When (s) turns on, (d1) turns on after the time that was set by (n). The delay time elapsed after (d1) turns on is set to (d2).
- When (s) turns off, (d1) turns off and the delay elapsed time is also reset.
- Use the long timer to count the elapsed time.

##### 2. Delay time setting

The valid setting range of (n) is T#1ms to T#2147483ms. Note that the valid setting range will be as follows by changing the timer limit setting using the engineering tool.

| Minimum value                                                                                                                                                               | Maximum value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Identical to the long timer setting value [ms] in the timer limit setting.<br>Note that if the long timer setting value is smaller than 1ms, the minimum value will be 1ms. | The time satisfying the following condition is used.<br>Note that the maximum value is a value that can be included within the range of time type because the delay time setting value is of time type (32-bit value). <ul style="list-style-type: none"> <li>• Delay time setting value [ms] <math>\leq</math> 2147483647 [ms] <math>\times</math> Long timer setting value of in the timer limit setting [ms]</li> </ul> [Example] <ul style="list-style-type: none"> <li>• If the long timer setting value is 0.001ms: T#1ms to T#2147483ms</li> <li>• If the long timer setting value is 1000ms: T#1000ms to T#2147483000ms</li> </ul> |

The value at the rising edge (off to on) of (d) is used for the setting value of (n). When the (n) value is changed while (s) is on, the new value will be enabled at the next rising edge of (s).

## ■ Operation result

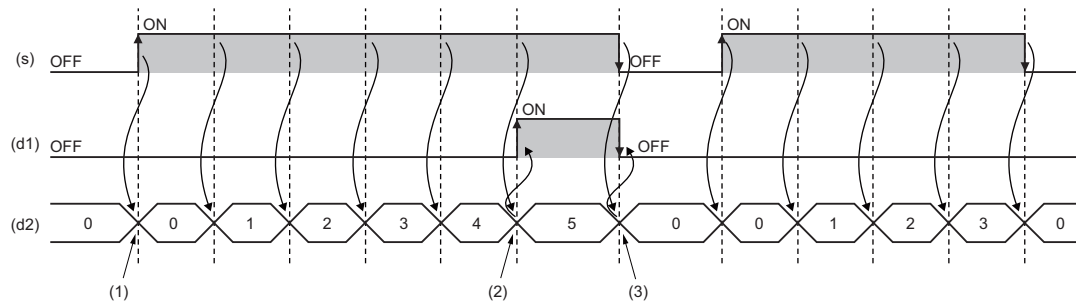
### 1. Function block without EN/ENO

The operation result will be as follows.

| Operation result   | (d1), (d2)                    |
|--------------------|-------------------------------|
| No operation error | Operation result output value |
| Operation error    | Undefined value               |

#### • Timing chart

When  $n=T\#5s$  (5s)



- (1) When (s) turns on, (d2) starts measuring time.  
 (2) When the time measured in (d2) reaches the time set in (n), (d1) turns on.  
 (3) When both (s) and (d1) turn off, the value in (d2) is initialized.

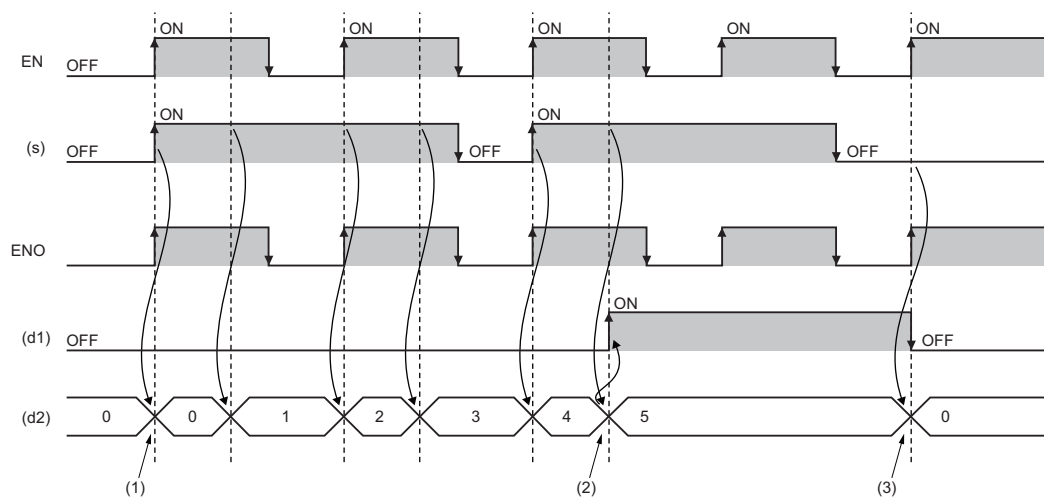
### 2. Function block with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result          |                               |
|----------------------|---------------------------|-------------------------------|
| EN                   | ENO                       | (d1), (d2)                    |
| TRUE (executed)      | TRUE (no operation error) | Operation result output value |
|                      | FALSE (operation error)   | Previous output value         |
| FALSE (not executed) | FALSE                     | Previous output value         |

#### • Timing chart

When  $n=T\#5s$  (5s)



- (1) When (s) turns on while EN is on, (d2) starts measuring time.  
 (2) When the time measured in (d2) reaches the time set in (n), (d1) turns on.  
 (3) When both (s) and (d1) turn off while EN is on, the value in (d2) is initialized.

## Operation error

| Error code (SD0) | Description                                            |
|------------------|--------------------------------------------------------|
| 3281H            | The output time setting value exceeds the valid range. |

## 42.7 Off Delay Timer

### TOF(\_E)

These function blocks turn off a signal after the specified period of time.

| Ladder, FBD/LD   |               | ST                                                                                                                                        |
|------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| [Without EN/ENO] | [With EN/ENO] | [Without EN/ENO]<br>Instance name(IN:=s,PT:=n,Q:=d1,ET:=d2);<br>[With EN/ENO]<br>Instance name(EN:=en,ENO:=eno,IN:=s,PT:=n,Q:=d1,ET:=d2); |

### Setting data

#### ■Description, type, data type

| Argument | Description                                                     | Type            | Data type |
|----------|-----------------------------------------------------------------|-----------------|-----------|
| EN       | Execution condition (TRUE: Executed, FALSE: Not executed)       | Input variable  | BOOL      |
| s (IN)   | Time measurement                                                | Input variable  | BOOL      |
| n (PT)   | Delay time setting value                                        | Input variable  | TIME      |
| ENO      | Output status (TRUE: Normal, FALSE: Abnormal or operation stop) | Output variable | BOOL      |
| d1 (Q)   | Output                                                          | Output variable | BOOL      |
| d2 (ET)  | Elapsed time                                                    | Output variable | TIME      |

### Processing details

#### ■Operation processing

##### 1. Output

- When (s) turns on, (d1) turns on.
- When (s) changes from on to off, (d1) turns off after the time that was set by (n). The delay time elapsed after (d1) turns off is set to (d2).
- Use the long timer to count the elapsed time.

##### 2. Delay time setting

The valid setting range of (n) is T#1ms to T#2147483ms. Note that the valid setting range will be as follows by changing the timer limit setting using the engineering tool.

| Minimum value                                                                                                                                                               | Maximum value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Identical to the long timer setting value [ms] in the timer limit setting.<br>Note that if the long timer setting value is smaller than 1ms, the minimum value will be 1ms. | The time satisfying the following condition is used.<br>Note that the maximum value is a value that can be included within the range of time type because the delay time setting value is of time type (32-bit value). <ul style="list-style-type: none"> <li>• Delay time setting value [ms] <math>\leq</math> 2147483647 [ms] <math>\times</math> Long timer setting value of in the timer limit setting [ms]</li> </ul> [Example] <ul style="list-style-type: none"> <li>• If the long timer setting value is 0.001ms: T#1ms to T#2147483ms</li> <li>• If the long timer setting value is 1000ms: T#1000ms to T#2147483000ms</li> </ul> |

The value at the falling edge (on to off) of (s) is used for the setting value of (n). When the (n) value is changed when (s) is off, the new value will be enabled at the next falling edge of (s).

## ■ Operation result

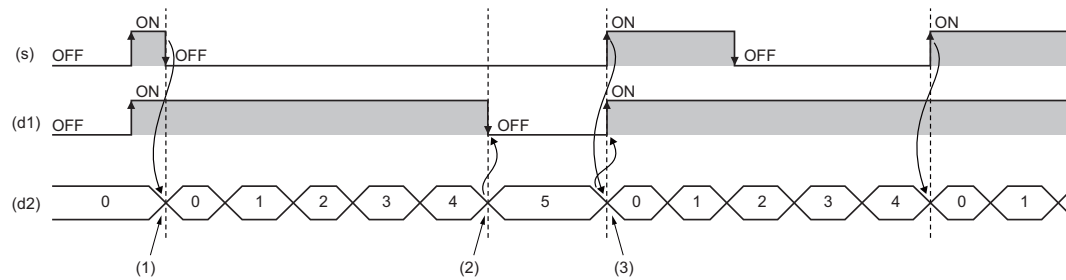
### 1. Function block without EN/ENO

The operation result will be as follows.

| Operation result   | (d1), (d2)                    |
|--------------------|-------------------------------|
| No operation error | Operation result output value |
| Operation error    | Undefined value               |

#### • Timing chart

When  $n=T\#5s$  (5s)



(1) When (s) turns off, (d2) starts measuring time.

(2) When the time measured in (d2) reaches the time set in (n), (d1) turns on.

(3) When (s) turns on, the value in (d2) is initialized.

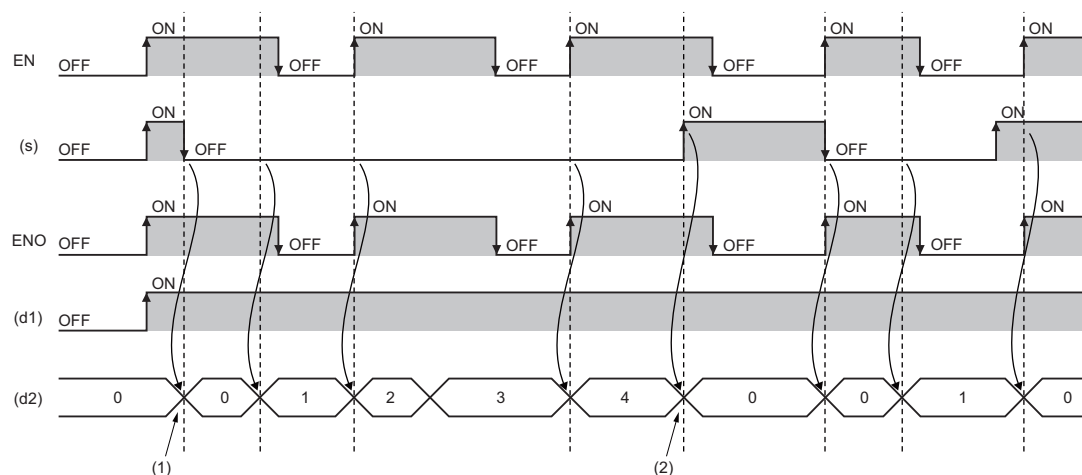
### 2. Function block with EN/ENO

The execution conditions and operation results will be as follows.

| Execution condition  | Operation result          |                               |
|----------------------|---------------------------|-------------------------------|
| EN                   | ENO                       | (d)                           |
| TRUE (executed)      | TRUE (no operation error) | Operation result output value |
|                      | FALSE (operation error)   | Previous output value         |
| FALSE (not executed) | FALSE                     | Previous output value         |

#### • Timing chart

When  $n=T\#5s$  (5s)



(1) When (s) turns off while EN is on, (d2) starts measuring time.

(2) When (s) turns on while EN is on, the value in (d2) is initialized.

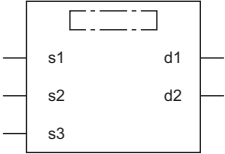
## Operation error

| Error code (SD0) | Description                                            |
|------------------|--------------------------------------------------------|
| 3281H            | The output time setting value exceeds the valid range. |

# 42.8 Timer Function Block

## TIMER\_□\_M

These function blocks start counting a timer when the execution condition is satisfied, and continue counting until the timer reaches the set value.

| Ladder, FBD/LD                                                                                                                                                                                                                               | ST                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
|  <p>(□ is to be replaced by any of the following: TIMER_10_FB_M, TIMER_100_FB_M, TIMER_HIGH_FB_M, TIMER_LOW_FB_M, TIMER_CONT_FB_M, or TIMER_CONTHFB_M.)</p> | Instance name(Coil:=s1,Preset:=s2,ValueIn:=s3,ValueOut:=d1,Status:=d2); |

### Setting data

#### ■Description, type, data type

| Argument      | Description                                               | Type            | Data type |
|---------------|-----------------------------------------------------------|-----------------|-----------|
| s1 (Coil)     | Execution condition (TRUE: Executed, FALSE: Not executed) | Input variable  | BOOL      |
| s2 (Preset)   | Timer setting value                                       | Input variable  | INT       |
| s3 (ValueIn)  | Initial timer value                                       | Input variable  | INT       |
| d1 (ValueOut) | Current timer value                                       | Output variable | ANY16     |
| d2 (Status)   | Output                                                    | Output variable | BOOL      |

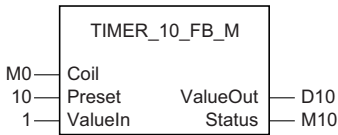
### Processing details

#### ■TIMER\_10\_FB\_M

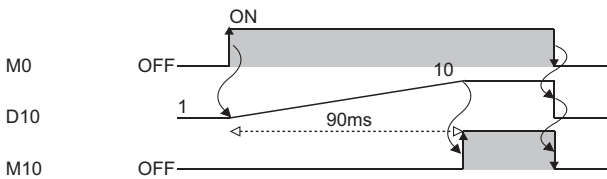
- When (s1) turns on, measurement of the current value starts. The measurement starts from (s3)×10ms. When the value reaches (s2)×10ms, (d2) turns on. The measured current value is output to (d1).
- When (s1) turns off, the current value (d1) becomes 0, and (d2) also turns off.
- If the unit of measurement of the high-speed timer (in the timer limit setting) is changed from the default value using the engineering tool, a warning will be issued during conversion of modified or newly added programs or all programs in a project.
- The valid setting range of (s2) is 0 to 32767.
- The valid setting range of (s3) is -32768 to 32767. Note that if a negative value is specified, 0 will be used as the initial value.

Ex.

[Ladder example]



[Timing chart]



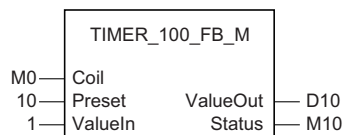


## ■TIMER\_100\_FB\_M

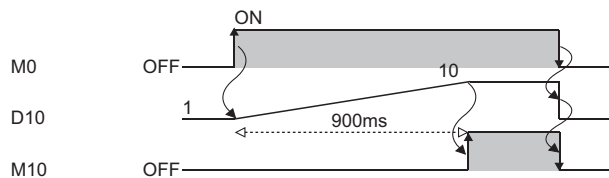
- When (s1) turns on, measurement of the current value starts. The measurement starts from (s3)×100ms. When the value reaches (s2)×100ms, (d2) turns on. The measured current value is output to (d1).
- When (s1) turns off, the current value (d1) becomes 0, and (d2) also turns off.
- If the unit of measurement of the low-speed timer (in the timer limit setting) is changed from the default value using the engineering tool, a warning will be issued during conversion of modified or newly added programs or all programs in a project.
- The valid setting range of (s2) is 0 to 32767.
- The valid setting range of (s3) is -32768 to 32767. Note that if a negative value is specified, 0 will be used as the initial value.

**Ex.**

[Ladder example]



[Timing chart]

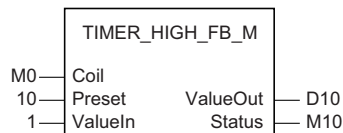


## ■TIMER\_HIGH\_FB\_M

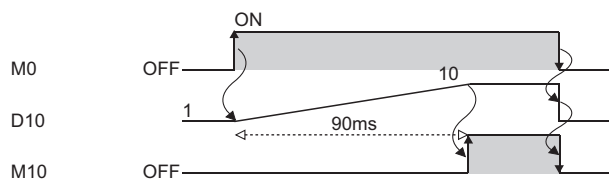
- This is a high-speed timer whose unit of measurement is 0.1 to 100ms. When (s1) turns on, measurement of the current value starts. The measurement starts from (s3)×0.1 to 100ms (variable; set in parameter). When the value reaches (s2)×0.1 to 100ms, (d2) turns on. The measured current value is output to (d1).
- When (s1) turns off, the current value (d1) becomes 0, and (d2) also turns off.
- The unit of measurement of the high-speed timer is 10ms by default. The unit can be changed in the range from 0.01 to 100ms.
- The valid setting range of (s2) is 0 to 32767.
- The valid setting range of (s3) is -32768 to 32767. Note that if a negative value is specified, 0 will be used as the initial value.

**Ex.**

[Ladder example]



[Timing chart]

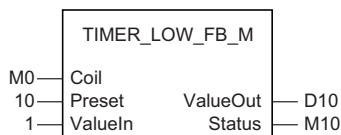


## ■TIMER\_LOW\_FB\_M

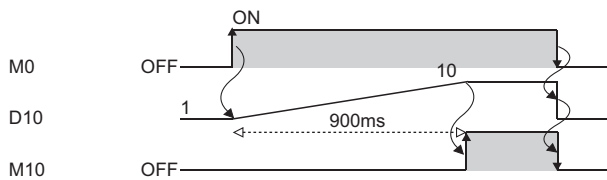
- This is a low-speed timer whose unit of measurement is 1 to 1000ms. When (s1) turns on, measurement of the current value starts. The measurement starts from (s3)×1 to 1000ms (variable; set in parameter). When the value reaches (s2)×1 to 1000ms, (d2) turns on. The measured current value is output to (d1).
- When (s1) turns off, the current value (d1) becomes 0, and (d2) also turns off.
- The unit of measurement of the low-speed timer is 100ms by default. The unit can be changed in the range from 1 to 1000ms (in increments of 1ms).
- The valid setting range of (s2) is 0 to 32767.
- The valid setting range of (s3) is -32768 to 32767. Note that if a negative value is specified, 0 will be used as the initial value.

**Ex.**

[Ladder example]



[Timing chart]



## ■TIMER\_CONT\_FB\_M/TIMER\_CONTHFB\_M

- This is a retentive timer that measures the on time of a variable. When (s1) turns on, measurement of the current value starts. There are two retentive timers: low-speed (TIMER\_CONT\_FB\_M) and high-speed (TIMER\_CONTHFB\_M) retentive timers.
- The measurement starts from (s3)×1 to 1000ms (0.1 to 100ms for the high-speed retentive timer) (variable; set in parameter). When the value reaches (s2)×1 to 1000ms (0.1 to 100ms for the high-speed retentive timer), (d2) turns on. The measured current value is output to (d1).
- Even when (s1) is off, the on/off states of (d1) and (d2) are held. When (s1) turns on again, the measurement resumes with the measured value that has been held.
- The unit of measurement (time limit) for the retentive timers is common to both the low-speed timer (TIMER\_LOW\_FB\_M) and high-speed timer (TIMER\_HIGH\_FB\_M).
  - Low-speed retentive timer: Low-speed timer
  - High-speed retentive timer: High-speed timer
- The valid setting range of (s2) is 0 to 32767.
- The valid setting range of (s3) is -32768 to 32767. Note that if a negative value is specified, 0 will be used as the initial value.
- To reset (d1) of a retentive timer, reset (s1) of FB directly.

### Ex.

Label name: TIMER\_CONT\_FB\_M\_1

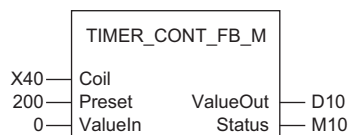
[Ladder program]



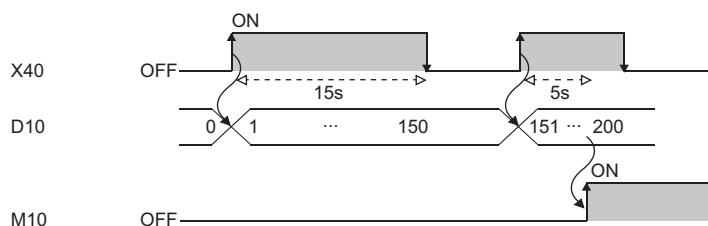
[ST program]

RST(M0,TIMER\_CONT\_FB\_M\_1.Coil)

[Ladder example]



[Timing chart]



### Operation error

There is no operation error.

# MEMO

---

This part consists of the following chapters.

43 MOTION CONTROL FB OVERVIEW

---

44 LIST OF MOTION CONTROL FUNCTION BLOCK VARIABLES

---

45 ADMINISTRATIVE FUNCTION BLOCKS

---

46 MOTION FUNCTION BLOCKS

---

47 STANDARD FUNCTION BLOCKS

---

# 43 MOTION CONTROL FB OVERVIEW

This chapter describes how to use motion control FBs and the specifications.

The motion control FB includes FBs established by PLCopen®. The basic specifications of I/O signals follow the PLCopen® motion control FBs.

For the common specifications of the function block, refer to the following.

☞ Page 66 Function Blocks (FB)

## 43.1 Motion Control FBs

This section describes the Motion control FBs.

### How to use Motion control FBs

The procedure for using Motion control FBs is described below.

1. Create the motion control FB instance (global label or local label) using the engineering tool.
2. Create a program which sets the I/O argument for the Motion control FB instance.
3. The control will be executed when Execution command (Execute) or Enable (Enable) of the Motion control FB is set to TRUE.

#### Point

- When one Motion control FB instance is being executed (including during buffering), the instance cannot be executed on multiple axes by changing the axis input (AXIS\_REF input or AXES\_GROUP\_REF input). The axis input of the Motion control FB can only be changed when an instance is not being executed. When the axis input is changed while an instance is being executed, a warning will occur and the change will be ignored. Therefore, ensure that the number of Motion control FB instances created is equal to the number of axes being controlled at the same time.
- Do not allow one motion control FB instance to be called from multiple programs (programs to be executed in parallel, including interrupt programs) at the same time. Operation when an instance is called at the same time cannot be guaranteed.

### Operation of motion control FBs for each system status

Motion control FBs can only be executed during RUN.

○: Available, ×: Not available

| System status  | Operation availability |
|----------------|------------------------|
| STOP           | ×                      |
| RUN            | ○                      |
| Moderate error | ×                      |
| Major error    | ×                      |

## Motion control FB types

Motion control FBs are classified according the operation details and the execution method.

### Administrative FBs/Motion related FBs/Standard FBs

Motion control FBs are classified into the following types according to the operation details.

| Type              | Operation details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Administrative FB | <ul style="list-style-type: none"> <li>• A motion control FB that takes an axis or an axes group for the argument and does not change the axis status or the axes group status by execution. (There are some exceptions.)</li> <li>• In most cases, an administrative FB can execute multiple instances to an axis or an axes group at the same time.</li> <li>• When multiple instances are executed for an axis or an axes group at the same time, control is preferentially performed from the one whose priority by which to execute the motion control FB is high.</li> </ul>                                                                                                                                                                                                                                              |
| Motion related FB | <ul style="list-style-type: none"> <li>• A motion control FB that takes an axis or an axes group for the argument and changes the axis status or the axes group status by execution.</li> <li>• In most cases, a motion FB can be executed to only one axis or axes group. However, some motion control FBs can be executed at the same time.</li> <li>• In most cases, the axis status or the axes group status will not be changed even if an administrative FB is executed while a motion related FB is being executed. However, some motion control FBs can cause a specific state transition.</li> <li>• When multiple instances are executed for an axis or an axes group at the same time, control is preferentially performed from the one whose priority by which to execute the motion control FB is high.</li> </ul> |
| Standard FB       | <ul style="list-style-type: none"> <li>• A motion control FB that does not take an axis or axes group for the argument.</li> <li>• A standard FB can execute multiple instances at the same time. Since it is not related to the axis, it does not affect either motion related FBs or administrative FBs.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

The following table lists the priority by which to execute motion control FBs.

—: No priority assignment

| Priority              | Motion control FB |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High<br>↑<br>↓<br>Low | 1                 | <ul style="list-style-type: none"> <li>• MC_Stop (Forced Stop)</li> <li>• MC_GroupStop (Group Forced Stop)</li> <li>• MCv_MoveWait (Axis Control Start Wait)</li> <li>• MCv_GroupMoveWait (Axis Group Control Start Wait)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                       | 2                 | <ul style="list-style-type: none"> <li>• MC_Home (OPR)</li> <li>• MC_MoveAbsolute (Absolute Value Positioning)</li> <li>• MC_MoveRelative (Relative Value Positioning)</li> <li>• MCv_Jog (JOG)</li> <li>• MC_MoveVelocity (Speed Control)</li> <li>• MC_TorqueControl (Torque Control)</li> <li>• MCv_SpeedControl (Speed Control (Including Position Loop))</li> <li>• MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)</li> <li>• MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control)</li> <li>• MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control)</li> <li>• MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control)</li> <li>• MC_SetPosition (Current Position Change)</li> <li>• MCv_SetTorqueLimit (Torque Limit Value)</li> <li>• MC_CamIn (Cam Operation Start)</li> <li>• MC_GearIn (Gear Operation Start)</li> <li>• MC_CombineAxes (Addition/Subtraction Positioning)</li> <li>• MCv_BacklashCompensationFilter (Backlash Compensation Filter)</li> <li>• MCv_SmoothingFilter (Smoothing Filter)</li> <li>• MCv_DirectionFilter (Moving Direction Restriction Filter)</li> <li>• MCv_SpeedLimitFilter (Speed Limit Filter)</li> <li>• MCv_AdvancedSync (Advanced Synchronous Control)</li> <li>• MCv_MovePositioningData (Multiple Axes Positioning Data Operation)</li> <li>• MCv_PositionControl (Absolute Position Tracking Control)</li> <li>• MCv_CyclicPosition (Motion Cyclic Position Control)</li> <li>• MCv_CyclicVelocity (Motion Cyclic Speed Control)</li> <li>• MCv_CyclicTorque (Motion Cyclic Torque Control)</li> </ul> |
|                       | 3                 | <ul style="list-style-type: none"> <li>• MC_TouchProbe (Touch Probe Enabled)</li> <li>• MCv_ChangeCycle (Current Value Change per Cycle)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                       | —                 | <ul style="list-style-type: none"> <li>• MC_GroupEnable (Axes Group Enabled)</li> <li>• MC_GroupDisable (Axes Group Disabled)</li> <li>• MC_Power (Operation Available)</li> <li>• MC_SetOverride (Override Value Setting)</li> <li>• MC_ReadParameter (Parameter Read)</li> <li>• MC_WriteParameter (Parameter Write)</li> <li>• MC_Reset (Axis Error Reset)</li> <li>• MC_GroupReset (Axes Group Error Reset)</li> <li>• MC_AbortTrigger (Touch Probe Disabled)</li> <li>• MC_CamTableSelect (Cam Table Selection)</li> <li>• MCv_ReadProfileData (Profile Read)</li> <li>• MCv_WriteProfileData (Profile Write)</li> <li>• MCv_AllPower (All Axes Operation Available)</li> <li>• MC_GroupSetOverride (Axes Group Override Value Setting)</li> <li>• MCv_MotionErrorReset (Motion Error Reset)</li> <li>• MCv_SyncOperationCycles (Control Operation Cycle Synchronization)</li> <li>• MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position per Cycle Calculation)</li> <li>• MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation)</li> <li>• MC_DigitalCamSwitch (Digital Cam Switch Output)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |



## Execution command (Execute) type/Enable (Enable) type

Some motion control FBs are executed with Execution command (Execute), while others are executed with Enable (Enable).

| Type              | Execution command (Execute) type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Enable (Enable) type                                                                                                                                                                                                                                                                                                                                                                                                                                 | Other types     |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Administrative FB | <ul style="list-style-type: none"> <li>• MC_GroupEnable (Axes Group Enabled)</li> <li>• MC_GroupDisable (Axes Group Disabled)</li> <li>• MC_SetPosition (Current Position Change)</li> <li>• MCv_SetTorqueLimit (Torque Limit Value)</li> <li>• MC_WriteParameter (Parameter Write)</li> <li>• MC_Reset (Axis Error Reset)</li> <li>• MC_GroupReset (Axes Group Error Reset)</li> <li>• MC_TouchProbe (Touch Probe Enabled)</li> <li>• MC_AbortTrigger (Touch Probe Disabled)</li> <li>• MC_CamTableSelect (Cam Table Selection)</li> <li>• MCv_ChangeCycle (Current Value Change per Cycle)</li> <li>• MCv_MotionErrorReset (Motion Error Reset)</li> <li>• MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position per Cycle Calculation)</li> <li>• MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>• MC_Power (Operation Available)</li> <li>• MC_SetOverride (Override Value Setting)</li> <li>• MC_ReadParameter (Parameter Read)</li> <li>• MCv_AllPower (All Axes Operation Available)</li> <li>• MC_GroupSetOverride (Axes Group Override Value Setting)</li> <li>• MCv_SyncOperationCycles (Control Operation Cycle Synchronization)</li> <li>• MC_DigitalCamSwitch (Digital Cam Switch Output)</li> </ul> | —               |
| Motion related FB | <ul style="list-style-type: none"> <li>• MC_Home (OPR)</li> <li>• MC_Stop (Forced Stop)</li> <li>• MC_GroupStop (Group Forced Stop)</li> <li>• MC_MoveAbsolute (Absolute Value Positioning)</li> <li>• MC_MoveRelative (Relative Value Positioning)</li> <li>• MC_MoveVelocity (Speed Control)</li> <li>• MC_TorqueControl (Torque Control)</li> <li>• MCv_SpeedControl (Speed Control (Including Position Loop))</li> <li>• MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)</li> <li>• MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control)</li> <li>• MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control)</li> <li>• MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control)</li> <li>• MC_CamIn (Cam Operation Start)</li> <li>• MC_GearIn (Gear Operation Start)</li> <li>• MC_CombineAxes (Addition/Subtraction Positioning)</li> <li>• MCv_MoveWait (Axis Control Start Wait)</li> <li>• MCv_GroupMoveWait (Axis Group Control Start Wait)</li> <li>• MCv_MovePositioningData (Multiple Axes Positioning Data Operation)</li> <li>• MCv_PositionControl (Absolute Position Tracking Control)</li> <li>• MCv_CyclicPosition (Motion Cyclic Position Control)</li> <li>• MCv_CyclicVelocity (Motion Cyclic Speed Control)</li> <li>• MCv_CyclicTorque (Motion Cyclic Torque Control)</li> </ul> | <ul style="list-style-type: none"> <li>• MCv_BacklashCompensationFilter (Backlash Compensation Filter)</li> <li>• MCv_SmoothingFilter (Smoothing Filter)</li> <li>• MCv_DirectionFilter (Moving Direction Restriction Filter)</li> <li>• MCv_SpeedLimitFilter (Speed Limit Filter)</li> <li>• MCv_AdvancedSync (Advanced Synchronous Control)</li> </ul>                                                                                             | • MCv_Jog (JOG) |
| Standard FB       | <ul style="list-style-type: none"> <li>• MCv_ReadProfileData (Profile Read)</li> <li>• MCv_WriteProfileData (Profile Write)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | —                                                                                                                                                                                                                                                                                                                                                                                                                                                    | —               |

The basic operation of each motion control FB by Execution command (Execute command) and Enable (Enable) is shown below. Note that some motion control FBs have different specifications.

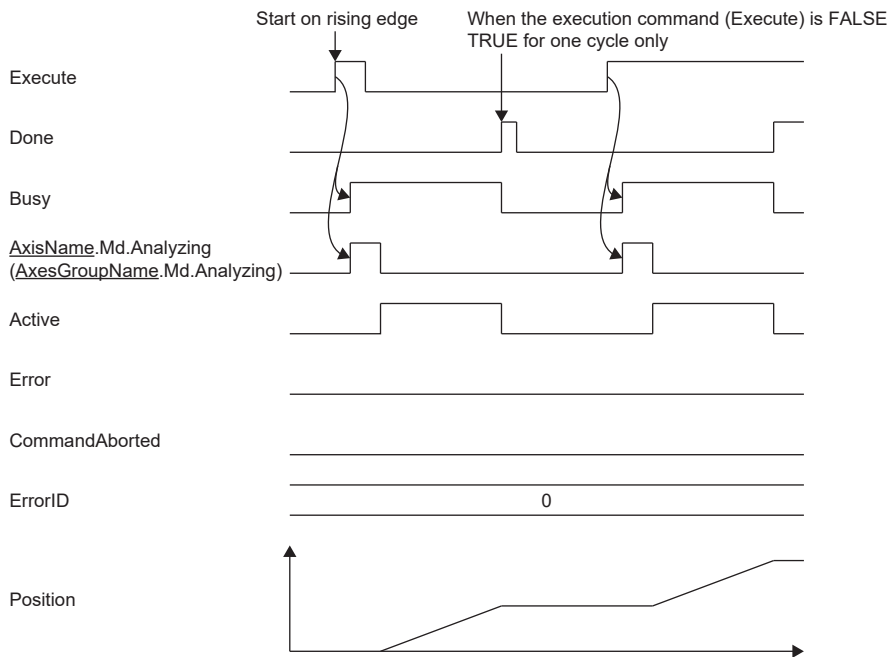
## ■ Basic operation of Execution command (Execute) type motion control FBs

- Execution command (Execute) type FBs read the input parameters at the rising edge of Execution command (Execute) and then start operation. Once operation has started, the operation will be continued until it is completed even if Execution command (Execute) is set to FALSE.
- When operation has started, only one output variable among Executing (Busy), Execution completion (Done), Error (Error), and Abortion of execution (CommandAborted) becomes TRUE.
- Execution completion (Done), Error (Error), Error code (ErrorID), and Abortion of execution (CommandAborted) are reset at the falling edge of Execution command (Execute). Executing (Busy) and Controlling (Active) are not affected.
- When changing the input parameter during operation, the change is reflected at restart (retrigger) of Execution command (Execute) or by continuous update using Continuous update (ContinuousUpdate).
- Analyzing (AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing) becomes TRUE from the rising edge of Executing (Busy), and Analyzing (AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing) becomes FALSE after starting the operation.
- When Execution command (Execute) is used in pulse, Execution completion (Done) becomes TRUE for one cycle only.

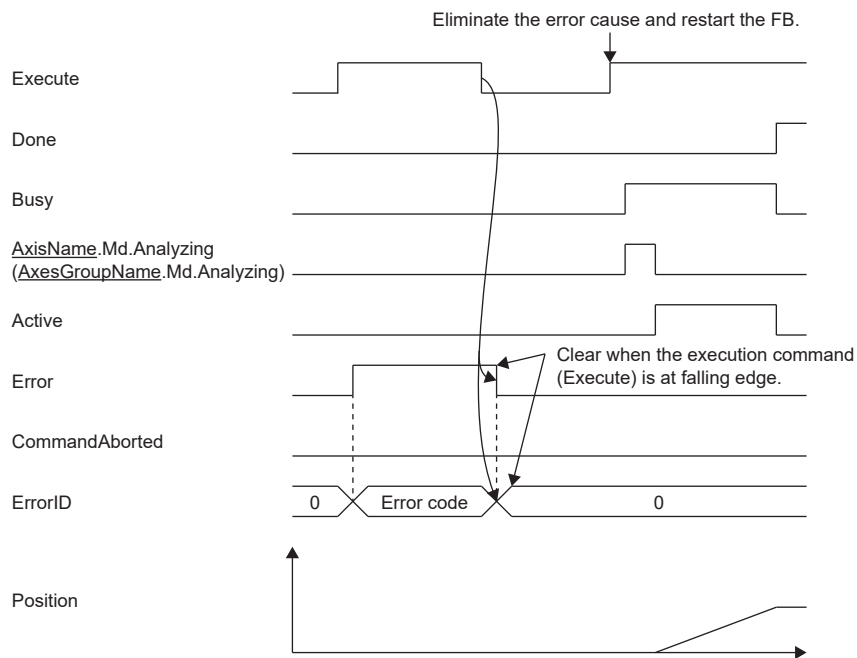
**Ex.**

The timing chart for Execution command (Execute) type motion control FBs is shown below.

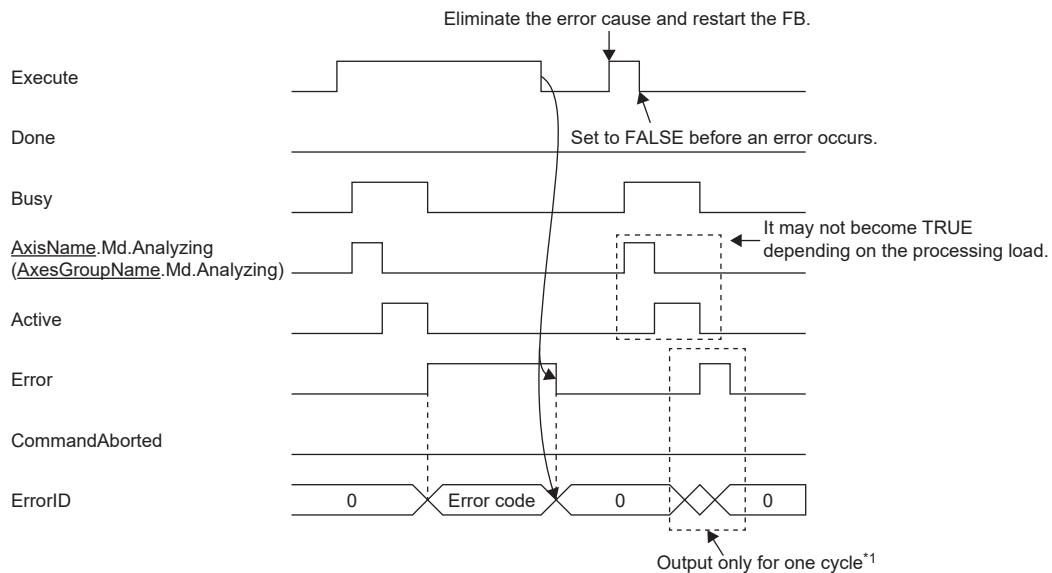
- When the FB is normal



- When the I/O variables are abnormal



- When the input variables are abnormal



\*1 The following operation is performed when the termination condition of the motion control FB (Execution command (Execute) is FALSE) is met. For motion control FBs not related to the axis or motion control FBs which do not stop with decelerating, Error (Error) becomes TRUE for one cycle only and Error code (ErrorID) is output. For motion control FBs that need to perform a deceleration stop, Error (Error) becomes TRUE until the stop with decelerating and Error code (ErrorID) is maintained. At stop completion of the axis, Error (Error) becomes FALSE and Error code (ErrorID) is cleared.

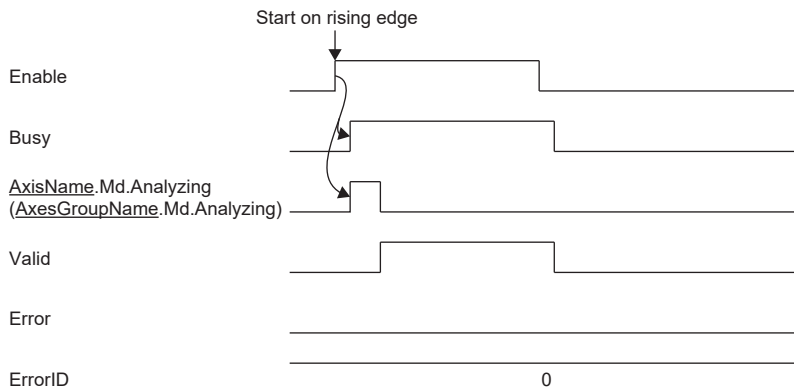
## ■ Basic operation of Enable (Enable) type motion control FBs

- Enable (Enable) type motion control FBs are continuously executed while Enable (Enable) is TRUE.
- Output value valid (Valid) indicates that the output is a valid value. After Output value valid (Valid) becomes FALSE, each output does not change.
- Only one output variable among Output value valid (Valid)/Enabled (Enabled)/Executing (Busy), Error (Error), and Abortion of execution (CommandAborted) becomes TRUE.
- Analyzing (AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing) becomes TRUE from the rising edge of Executing (Busy), and Analyzing (AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing) becomes FALSE after starting the operation.
- Output variables not listed above are reset on the falling edge of Enable (Enable). (The reset timing is the same as Output value valid (Valid)/Enabled (Enabled)/Executing (Busy), Error (Error), and Abortion of execution (CommandAborted).)

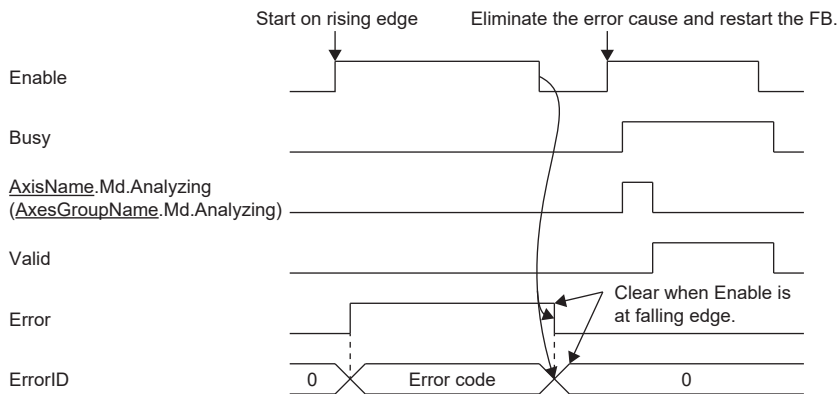
### Ex.

The timing chart for Enable (Enable) type motion control FBs is shown below.

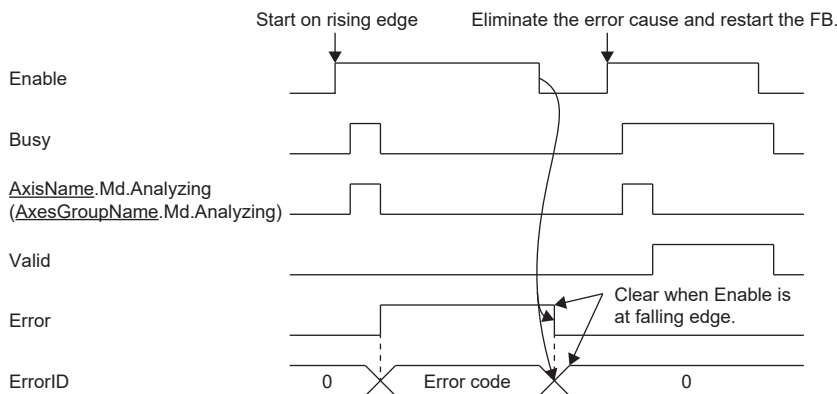
- When the FB is normal



- When the I/O variables are abnormal



- When the input variables are abnormal



## Motion control types

The following types of axis and axes group control can be executed by motion related motion control FBs.

| Large classification | Middle classification | Small classification | Description                                                                                                                                                                                                                                                              |
|----------------------|-----------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis control         | Single axis control   | Positioning control  | Control in which Axis status ( <u>AxisName</u> .Md.AxisStatus) is set to "5: During positioning operation (DiscreteMotion)" and the axis is moved to the target position.                                                                                                |
|                      |                       | Continuous control   | Control in which Axis status ( <u>AxisName</u> .Md.AxisStatus) is set to "6: During continuous operation (ContinuousMotion)" and continuous control is performed for the axis.                                                                                           |
|                      |                       | Synchronous control  | Control which has Master axis (Master) and Slave axis (Slave) as I/O variables and performs synchronous control for the axis with the Axis status ( <u>AxisName</u> .Md.AxisStatus) of Slave axis (Slave) set to "7: During synchronous operation (SynchronizedMotion)". |
|                      |                       | Manual control       | Positioning control FBs, continuous control FBs, and synchronous control FBs whose type is Enable (Enable) and whose output variable is Execution completion (Done)                                                                                                      |
|                      |                       | Homing control       | Control in which Axis status ( <u>AxisName</u> .Md.AxisStatus) is set to "3: During home position return (Homing)" and continuous control is performed for the axis.                                                                                                     |
| Axes group control   | Multiple axes control | Positioning control  | Control in which Axes group status ( <u>AxesGroupName</u> .Md.GroupStatus) is set to "5: Operating (GroupMoving)" and the axis is moved to the target position.                                                                                                          |

## Error processing

If an error occurs while the motion control FB is executed, Error (Error) becomes TRUE and the error code is output to Error code (ErrorID). At this time, for an axis, Axis status (AxisName.Md.AxisStatus) transitions to "1: Stopping on error (ErrorStop)", and for an axes group, Axes group status (AxesGroupName.Md.GroupStatus) transitions to "1: Stopping on error (GroupErrorStop)".

When the axis status of an available axis transits to the "1: Stopping on error (ErrorStop)" status, all buffering FBs are aborted. Error (Error) of the aborted motion control FBs becomes TRUE.

After that, an error reset needs to be executed to start the axis or axes group.

For how to check errors of the axis or axes group and how to reset the error, refer to the following.

 User's manual for the controller used

### Point

One of the following values is output to Error code (ErrorID). (The value output depends on the control.) However, event codes are not output.

- Axis error code (AxisName.Md.ErrorID)
- Axes group error code (AxesGroupName.Md.ErrorID)
- Latest motion system error code (MotionSystem.Md.ErrorID)

## Units used in control

Units for the position, velocity, acceleration/deceleration, and jerk that are used in the Motion system follow the technical units of the axis to be used.

The following types exist for the control values, such as the position and the velocity, that are used in the Motion system.

For details on the axis technical units and control values related to the position and the velocity, refer to the following.

 User's manual for the controller used

| Type            | Description                                                                                                                                                                             |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Commanded value | A value (target value) based on an input to the motion control FB.<br>(Such as commanded position and commanded velocity)                                                               |
| Set value       | The current control value that is generated by Motion operation.<br>(Such as set position and set velocity)                                                                             |
| Actual value    | A value obtained by converting the actual value received from the device station by the real axis into the technical unit of the axis.<br>(Such as actual position and actual velocity) |

## I/O variables used in motion control FBs

This section describes the I/O variables used in motion control FBs.

For motion control FBs, the I/O variables, input variables, and output variables must be defined.

### I/O variables

These variables set the axis and axes group of the drive unit to be controlled, including Axis information (Axis) and Axes group information (AxesGroup).

Axes and axes groups are generated/initialized by setting axis settings and the axes group setting in the engineering tool.

The set axis and axes group are assigned as an axis variable or an axes group variable in the global label data.

For details on the axis and axes groups, refer to the following.

 User's manual for the controller used

### Input variable

These variables set operation conditions such as the target position and the command velocity.

### Output variable

These variables output the motion control FB status, drive unit status, whether there is an error, or other status.

### Class

The following are the classes of the I/O variables, input variables, and output variables.

| Variable        | Class      |
|-----------------|------------|
| I/O variable    | VAR_IN_OUT |
| Input variable  | VAR_INPUT  |
| Output variable | VAR_OUTPUT |

### Data types

Variables are classified into different types based on their bit length, processing method, value range, or others.

For details on data types, refer to the following.

 Page 30 Data Specification Method

### Omission of input arguments

When omitting motion control FB inputs, the default value that is defined for each motion control FB is applied. For details on the default values, refer to the section for the motion control FB to be used.

When omitting inputs such as the velocity in the multiple start motion control FB, the input value of the previous motion control FB is carried over.

### Refresh timing of inputs/outputs

Each argument of the motion control FB is refreshed at the call timing of the motion control FB. To control the input/output of the motion control FB synchronizing with the operation cycle, call the motion control FB from a fixed cycle program whose cycle is the same as the operation cycle.

Specification of I/O No.

When using a motion control FB, the I/O No. must be set in the I/O variables that are used in the motion control FB (example: I/O No. (AxisName.AxisRef.StartIO)). (For input/output variables used in motion control FBs (example: I/O No. (AxisName.AxisRef.StartIO)), only the default value can be used.)

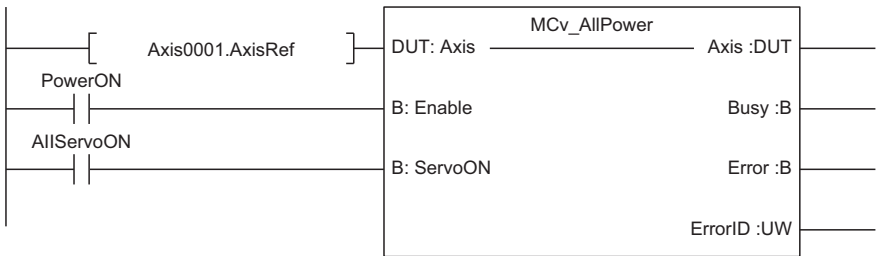
When setting the I/O No., AXIS\_REF of the axis variables or axes group variables (AxisName.AxisRef for axis variables and AxesGroupName.AxesGroupRef for axes group variables) is used.

The members (Axis No. (AxisNo), Axes group No. (GroupNo), I/O No. (StartIO)) in AXIS\_REF of the axis variables and axes group variables already have the I/O No. specified as a structure, so the I/O No. can be set without specification by just setting the axis label.

When setting the I/O No., using the Axis information (AxisName.AxisRef) label to perform the setting is recommended. In addition, any Axis information (AxisName.AxisRef) label can be set.

Ex.

When the label for Axis 1 (Axis0001) is used and MCv\_AllPower (All Axes Operation Available) is executed



\*1 Information for the following members is included in the Axis information (AxisName.AxisRef) label.

| Name          | Setting value | Label name               |
|---------------|---------------|--------------------------|
| Axis No.      | 1             | Axis0001.AxisRef.AxisNo  |
| Start I/O No. | 3E00H         | Axis0001.AxisRef.StartIO |



## Precautions for the motion control FB

- I/O arguments of the motion control FB are refreshed at the call timing of the motion control FB, but the cycle that the control is actually executed in differs depending on the motion control FB. For example, motion related FBs perform the control at the operation cycle regardless of the motion control FB call task (normal/fixed cycle). For details, refer to the section for the motion control FB to be used.
- The timing for refreshing the output arguments of the motion control FBs differs from the timing for refreshing axis variables and other related labels. For this reason, the timing chart provided for each function may not always match the actual signal changes. Create a program considering the refresh cycle of each signal.
- For motion control FBs in operation (Executing (Busy) is TRUE), call the motion control FB. If the motion control FB is not called into the program, control continues. However, changes to the input variable values will not be reflected in control, and it will no longer be possible to update output variables such as errors and Execution Completion.
- Do not use the motion control FB in an initial execution type program as an FB call may stop while the motion control FB is in operation.
- When used between the FOR and NEXT instructions or in combination with a control syntax (IF statement, FOR statement, and CASE statement), check Executing (Busy) and Execution completion (Done) so that the motion control FB is called before the execution of the motion control FB is complete.
- The motion control FB imports input values when Execution command (Execute) or Enable (Enable) is set to TRUE. Therefore, set input values before setting Execution command (Execute) or Enable (Enable) to TRUE. In addition, when changing multiple input arguments by a retrigger/continuous update of the motion control FB, change them by the same task as the motion control FB call task to match the import timing of each argument.
- When changing Execution command (Execute) to FALSE after it has been set to TRUE, wait until after Executing (Busy) has changed to the TRUE status before setting Execution command (Execute) to FALSE.
- The motion control function uses real number data (floating-point data) for the axis current position, motion control FB target position, or others. Therefore, it may include a truncation error. For example, when repeatedly executing positioning in relative position specification, such as with MC\_MoveRelative (Relative Value Positioning), the truncation error may cumulate between the set position and the specified movement value. If the truncation error is a problem, execute positioning in absolute position specification, such as with MC\_MoveAbsolute (Absolute Value Positioning). In addition, the truncation error that occurs in the real number data processing within the function can be suppressed by setting real number type parameters related to the Motion control function so that there is no number after the decimal point. For details on the real number data (floating-point data) used in motion control FBs, refer to the following.

 Page 39 Real number data (floating-point data)

- Do not allow one motion control FB instance to be called from multiple programs (programs to be executed in parallel, including interrupt programs) at the same time. Operation when an instance is called at the same time cannot be guaranteed.

# 43.2 Motion Control FB Configuration

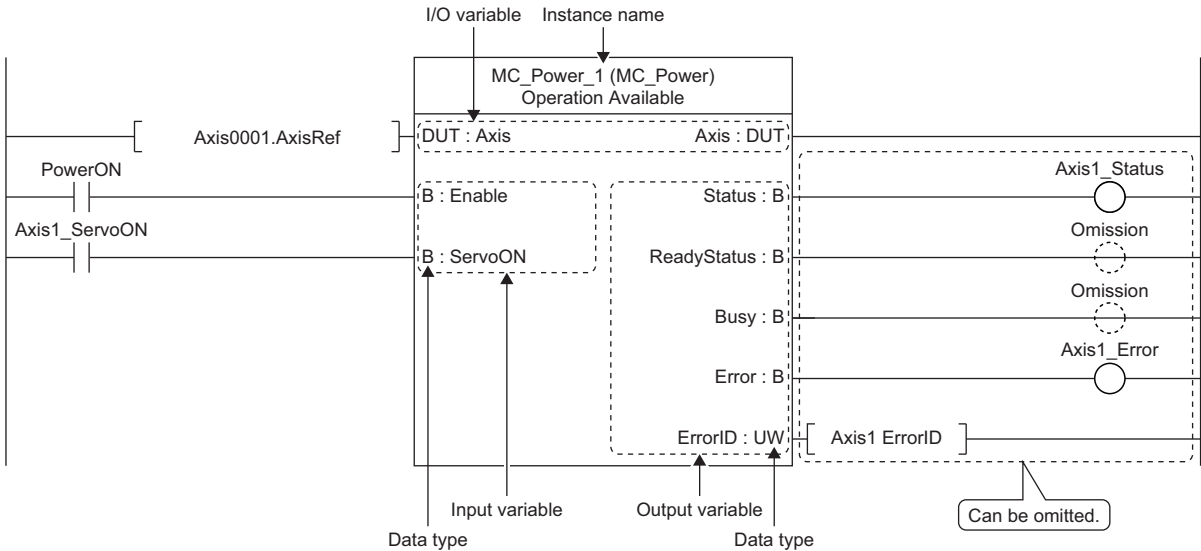
This section describes how to write each program language for the motion control FB.

## Ladder

In the ladder language, the motion control FB is arranged as follows.

Ex.

If MC\_Power (Operation Available)



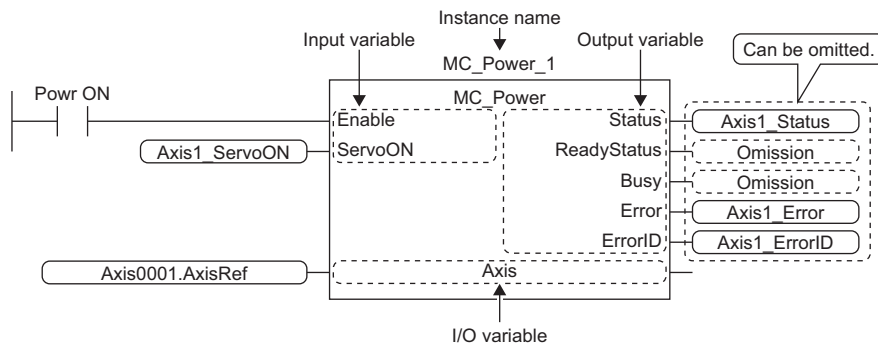
| Name            | Description                                                                                                                                                                                                                                           |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Instance name   | The instance name assigned to each FB.<br>The instance name can be changed.                                                                                                                                                                           |
| I/O variable    | These variables set the axis variable names of the drive unit (or other devices) to be controlled, including Axis information (Axis) and Axes group information (AxesGroup).                                                                          |
| Input variable  | These variables set operation conditions such as the target position and the command velocity.<br>The setting of these variables can be omitted. When omitted, the default value is used.                                                             |
| Output variable | These variables output the FB status and drive unit status.                                                                                                                                                                                           |
| Data type       | Displays the data type of I/O variables, input variables, and output variables.<br>For details on the data type of I/O variables, input variables, and output variables, refer to the following.<br><a href="#">Page 30 Data Specification Method</a> |

## FBD/LD (Function block diagram/ladder)

In the FBD/LD language, the motion control FB is arranged as follows.

**Ex.**

If MC\_Power (Operation Available)



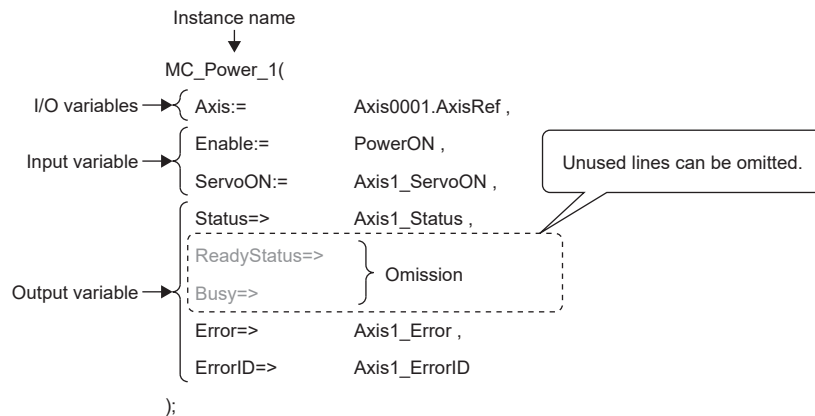
| Name            | Description                                                                                                                                                                               |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Instance name   | The instance name assigned to each FB.<br>The instance name can be changed.                                                                                                               |
| I/O variable    | These variables set the axis variable names of the drive unit (or other devices) to be controlled, including Axis information (Axis) and Axes group information (AxesGroup).              |
| Input variable  | These variables set operation conditions such as the target position and the command velocity.<br>The setting of these variables can be omitted. When omitted, the default value is used. |
| Output variable | These variables output the FB status and drive unit status.                                                                                                                               |

## ST (Structured text)

In the ST language, the Motion control FB is arranged as follows.

**Ex.**

If MC\_Power (Operation Available)



| Name            | Description                                                                                                                                                                               |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Instance name   | The instance name assigned to each FB.<br>The instance name can be changed.                                                                                                               |
| I/O variable    | These variables set the axis variable names of the drive unit (or other devices) to be controlled, including Axis information (Axis) and Axes group information (AxesGroup).              |
| Input variable  | These variables set operation conditions such as the target position and the command velocity.<br>The setting of these variables can be omitted. When omitted, the default value is used. |
| Output variable | These variables output the FB status and drive unit status.                                                                                                                               |

# 44 LIST OF MOTION CONTROL FUNCTION BLOCK VARIABLES

This chapter describes the list of variables used in motion control FBs.

## 44.1 List of Variables

The following types of variables are handled in Motion control.

| Variable                              |                          | Description                                                                                                                                             | Reference                                                         |
|---------------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Axis variable                         |                          | Variables for axes configured with parameter data such as the axis type or monitor data such as the axis current position.                              | Page 1444 Axis variables                                          |
| Axes group variable                   |                          | Variables for axes groups configured with parameter data such as configuration axes or monitor data such as the axis group status.                      | Page 1468 Axes group variables                                    |
| System variable                       |                          | Variables for systems configured with parameter data relating to add-ons or monitor data such as the operation cycle.                                   | Page 1475 System variables                                        |
| Advanced synchronous control variable | Input axis variable      | Variables for input axes configured with parameter data for advanced synchronous control input axes or monitor data such as the axis current position   | Page 1479 Input axis variable                                     |
|                                       | Output axis variable     | Variables for output axes configured with parameter data for advanced synchronous control output axes or monitor data such as the axis current position | Page 1481 Output axis variable                                    |
|                                       | System variable          | Variables for systems configured with parameter data relating to advanced synchronous control add-ons or monitor data                                   | Page 1486 System variable (Advanced synchronous control)          |
|                                       | Other structure variable | Variables for structures used in advanced synchronous control that are classified outside those listed above                                            | Page 1507 Other structure variable (Advanced synchronous control) |
| Other structure variable              |                          | Variables for structures in a classification not listed above.                                                                                          | Page 1487 Other structure variables                               |



In this manual, variables listed with a portion of the variable underlined indicates that the variable name is defined by the user.

AxisName.AxisRef.AxisNo



A variable to be defined by the user

## How to read the list of variables

Each item in the list of variables has the following meaning.

### ■Import

| Item                                     | Description                                                                                                                                                                                   |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operation cycle                          | The timing for executing each operation cycle                                                                                                                                                 |
| Normal                                   | The timing for executing normal tasks of the Motion system                                                                                                                                    |
| Service                                  | The timing for executing the motion service processing control                                                                                                                                |
| Immediately                              | When an event occurs                                                                                                                                                                          |
| At start                                 | When the FB starts                                                                                                                                                                            |
| At stop                                  | When the FB stops                                                                                                                                                                             |
| At system start                          | When the Motion system starts                                                                                                                                                                 |
| When connecting device                   | When a device station is connected                                                                                                                                                            |
| Ready ON                                 | When "PLC Ready (MotionSystem.Cd.SequenceReady)" is turned on                                                                                                                                 |
| System basic cycle                       | The timing for executing the system basic cycle processing                                                                                                                                    |
| Operation cycle (GroupEnable)            | The timing for executing each operation cycle (GroupEnable)                                                                                                                                   |
| When axes group is valid                 | The timing when the axes group becomes valid                                                                                                                                                  |
| Operation cycle (FB is starting)         | The timing for executing operation cycle processing (FB is starting)                                                                                                                          |
| When the 0th point of cam data is passed | When the current position of one cycle passes the 0th point of the cam data currently being executed <example><br>The timing of when the 0th point position was passed for cam resolution 512 |

### ■Attribute

| Display         | Description                                           |
|-----------------|-------------------------------------------------------|
| LIST_WRITE_BACK | Label list (Write back to initial value possible)     |
| LIST_READ_ONLY  | Label list (Write back to initial value not possible) |

# Axis variables

Axis variables are assigned the following data types based on the axis type.

| Axis type            | Data type            |
|----------------------|----------------------|
| Real drive axis      | AXIS_REAL            |
| Real encoder axis    | AXIS_ENCODER         |
| Virtual drive axis   | AXIS_VIRTUAL         |
| Virtual encoder axis | AXIS_VIRTUAL_ENCODER |
| Virtual link axis    | AXIS_VIRTUAL_LINK    |



The axis variables that can be set differ depending on the axis type used. ( Page 1463 Variables settable as the axis variable for each axis type)

Each axis data type has the following members.

| Member name | Data type <sup>*1*2</sup> | Description                                                                                                                                                                                                                                         | Reference                                                              |
|-------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| AxisRef     | AXIS_REF                  | The data structure for input/output of the Motion control FBs.<br>The type is fixed regardless of the axis type.                                                                                                                                    | Page 1444 <a href="#">AxisName.AxisRef</a> . (Axis information)        |
| PrConst     | AXIS_□_PRM_CONST          | Stores the axis parameter data (constant).<br>Opens the setting value at the axis variable initialization.<br>Reload to the control is not executed after the axis variable initialization.                                                         | Page 1445 <a href="#">AxisName.PrConst</a> . (Axis parameter constant) |
| Pr          | AXIS_□_PRM                | Stores the axis parameter data.<br>Opens the default value at the axis variable initialization.<br>Reload to the control is executed after the axis variable initialization.<br>The fetch timing to the control changes depending on the parameter. | Page 1449 <a href="#">AxisName.Pr</a> . (Axis parameter)               |
| Md          | AXIS_□_MONI               | Stores the axis monitor data.<br>Executes refresh in the fixed cycle for each monitor data.                                                                                                                                                         | Page 1453 <a href="#">AxisName.Md</a> . (Axis monitor data)            |
| Cd          | AXIS_□_CMD                | Stores the axis control command data.<br>Acquires the latest value every control operation cycle and uses it for the control.                                                                                                                       | Page 1462 <a href="#">AxisName.Cd</a> . (Axis control data)            |

\*1 □: The data type of each axis type

\*2 The members of the data type differ depending on the axis type.

## AxisName.AxisRef. (Axis information)

| Variable name | Name     | Import | Data type  | Attribute           | Description                                                                                                                                                               |
|---------------|----------|--------|------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxisNo        | Axis No. | —      | WORD(UINT) | LIST_WRIT<br>E_BACK | The axis No. is set.<br>• 0: Not set<br>• 1 to 10000: Set axis No.                                                                                                        |
| StartIO       | I/O No.  | —      | WORD(HEX)  | LIST_WRIT<br>E_BACK | The I/O No. is set.<br>By default, 3E0H is automatically input.<br>• 000H to 0FFH: The start I/O number (the first three digits when expressed in four-digit hexadecimal) |

## AxisName.PrConst. (Axis parameter constant)

| Variable name                | Name                                   | Import          | Data type                                                            | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------|----------------------------------------|-----------------|----------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AddressOfStation             | Station address setting                | At system start | WSTRING(63)                                                          | LIST_WRITE<br>_BACK | <p>The network address (IP address) of the device station is set with a string.</p> <p>When multiple logic axes are included in one station such as with a multi-axis drive unit, set multi-drop numbers to identify certain logic axes.</p> <p>■For a single axis device</p> <pre> 192.168.3.1       +--- IP address           </pre> <p>■For a multi-axis device</p> <p>&lt;Example&gt; C-axis of MR-J5W-G</p> <pre> 192.168.3.1#2                   +--- IP address   +--- Multidrop number           </pre> <p>* The multi-drop No. is set as "# + No. (decimal)".</p> <ul style="list-style-type: none"> <li>• #0: A-axis</li> <li>• #1: B-axis</li> <li>• #2: C-axis</li> </ul> <p>* The multi-drop No. can be omitted. When it is omitted, it is regarded as "#0".</p>                                                                                                                                                                                                                            |
| AxisType                     | Axis type setting                      | At system start | INT<br>(MC_AXIS_TYPE)<br>☞ Page 1523<br>MC_AXIS_TYPE                 | LIST_WRITE<br>_BACK | <p>The axis type is set.</p> <ul style="list-style-type: none"> <li>• 0: Real Drive Axis (DriveAxis)</li> <li>• 2: Real Encoder Axis (EncoderAxis)</li> <li>• 3: Virtual drive axis (VirtualDriveAxis)</li> <li>• 4: Virtual encoder axis (VirtualEncoderAxis)</li> <li>• 5: Virtual link axis (VirtualLinkAxis)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Encoder_AxisType             | Real encoder axis type setting         | At system start | INT<br>(MC_ENCODER_AXIS_TYPE)<br>☞ Page 1523<br>MC_ENCODER_AXIS_TYPE | LIST_WRITE<br>_BACK | <p>The type of the real encoder axis is set.</p> <ul style="list-style-type: none"> <li>• 1: Via Drive Unit (Drive)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Encoder_CounterDisableSignal | Counter disabling signal               | At system start | SIGNAL_SELECT<br>☞ Page 1492<br>SIGNAL_SELECT<br>(Signal select)     | LIST_WRITE<br>_BACK | <p>The signal to switch to the counter disable is set.</p> <p>Settings and operations specific to Counter disabling signal (Encoder_CounterDisableSignal) are shown below.</p> <p>■Target (Target)</p> <ul style="list-style-type: none"> <li>• Data type can only be set to [VAR], [DEV], and [CONST].</li> <li>• For the network synchronous communication setting of the device station referred to when [VAR] or [DEV] is specified, only "Synchronize" can be specified.</li> </ul> <p>■Signal detection method (Detection)</p> <p>Allows detection at the following setting level only.</p> <ul style="list-style-type: none"> <li>• 0: Detection at TRUE (HighLevel)</li> <li>• 1: Detection at FALSE (LowLevel)</li> </ul> <p>■Compensation time (CompensationTime)</p> <p>Can only be set to 0.0[s].</p> <p>■Filter time (FilterTime)</p> <p>The setting range is "0.0 to 5.0 [s]".</p> <p>* If a value outside the range is set, Out of Parameter Range (Axis) (error code: 1A60H) occurs.</p> |
| Encoder_RingCout_LowerValue  | Encoder ring counter lower limit value | At system start | DINT                                                                 | LIST_WRITE<br>_BACK | <p>The encoder ring counter lower limit value is set.</p> <p>■One-word PosActualValue</p> <ul style="list-style-type: none"> <li>• -32768 to 32767</li> </ul> <p>* If a value outside the 1-word range is set, Out of Parameter Range (Axis) (error code: 1A60H) occurs.</p> <p>■Two-word PosActualValue, or if omitted</p> <ul style="list-style-type: none"> <li>• -2147483648 to 2147483647</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Encoder_RingCout_UpperValue  | Encoder ring counter upper limit value | At system start | DINT                                                                 | LIST_WRITE<br>_BACK | <p>The encoder ring upper limit value is set.</p> <p>■One-word PosActualValue</p> <ul style="list-style-type: none"> <li>• -32768 to 32767</li> </ul> <p>* If a value outside the 1-word range is set, Out of Parameter Range (Axis) (error code: 1A60H) occurs.</p> <p>■Two-word PosActualValue, or if omitted</p> <ul style="list-style-type: none"> <li>• -2147483648 to 2147483647</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

| Variable name           | Name               | Import          | Data type                                                        | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------|--------------------|-----------------|------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HwStrokeLimit_FlsSignal | Upper limit signal | At system start | SIGNAL_SELECT<br>📄 Page 1492<br>SIGNAL_SELECT<br>(Signal select) | LIST_WRITE<br>_BACK | <p>The signal to use the upper limit signal (FLS) is set. It may be regarded as signal detection depending on the variable used as an external signal and the status of devices controlled by the controller.</p> <p>Settings and operations specific to Upper limit signal (HwStrokeLimit_FlsSignal) are shown below.</p> <p>■I/O number (StartIO)<br/>Ignores the input value.</p> <p>■Target (Target)<br/>If Target is not specified, the signal is regarded as disabled and the signal non-detection status is always set. Also, Hardware Stroke Limit Override (<u>AxisName</u>.Md.HwStrokeLimit_Override) is not imported. The data type that can be specified is only [VAR], [DEV], or [CONST].</p> <p>*: If an unavailable value is set, Out of Parameter Range (Axis) (error code: 1A60H) occurs. The cause can be checked with the following detail codes.</p> <ul style="list-style-type: none"> <li>• An invalid string is set (detail code: 0001H).</li> <li>• An unusable data type is set (detail code: 0002H).</li> <li>• An unusable type is specified (detail code: 0003H).</li> <li>• A type other than a numeric type is specified when the label is specified (detail code: 0004H).</li> <li>• A non-existent signal is set (detail code: 0005H).</li> <li>• A global label whose access from an external device is invalid is set (detail code: 0005H).</li> <li>• The upper limit of the number of characters is exceeded (detail code: 0007H).</li> <li>• "Asynchronous" is set for the network synchronous communication setting of the device station referred to (detail code: 8002H).</li> <li>• An unsupported device is set (detail code: 8002H).</li> <li>• A device number out of range is set (detail code: 8002H).</li> </ul> <p>■Signal detection method (Detection)<br/>The specification is allowed at the following level detection only.</p> <ul style="list-style-type: none"> <li>• 0: Detection at TRUE (HighLevel)</li> <li>• 1: Detection at FALSE (LowLevel)</li> </ul> <p>* If a value outside the range is set, Out of Parameter Range (Axis) (error code: 1A60H (detail code: 8003H)) occurs.</p> <p>■Compensation time (CompensationTime)<br/>Ignores the input value.</p> <p>■Filter time (FilterTime)<br/>The setting range is "0.0 to +5.0 [s]".</p> <p>* If a value outside the range is specified, Out of Filter Time Setting Range of Each Axis Signal Warning (event code: 00D24H) occurs, and the axis operates with 0.0 of the filter time.</p> |



| Variable name               | Name                              | Import          | Data type                                                      | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------|-----------------------------------|-----------------|----------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HwStrokeLimit_RlsSignal     | Lower limit signal                | At system start | SIGNAL_SELECT<br>Page 1492<br>SIGNAL_SELECT<br>(Signal select) | LIST_WRITE<br>_BACK | <p>The signal to use the lower limit signal (RLS) is set. It may be regarded as signal detection depending on the variable used as an external signal and the status of devices controlled by the controller.</p> <p>Settings and operations specific to Lower limit signal (HwStrokeLimit_RlsSignal) are shown below.</p> <p>■ I/O number (StartIO)<br/>Ignores the input value.</p> <p>■ Target (Target)<br/>If Target is not specified, the signal is regarded as disabled and the signal non-detection status is always set. Also, control data is not imported.</p> <p>The data type that can be specified is only [VAR], [DEV], or [CONST].</p> <p>*: If an unavailable value is set, Out of Parameter Range (Axis) (error code: 1A60H) occurs. The cause can be checked with the following detail codes.</p> <ul style="list-style-type: none"> <li>• An invalid string is set (detail code: 0001H).</li> <li>• An unusable data type is set (detail code: 0002H).</li> <li>• An unusable type is specified (detail code: 0003H).</li> <li>• A type other than a numeric type is specified when the label is specified (detail code: 0004H).</li> <li>• A non-existent signal is set (detail code: 0005H).</li> <li>• A global label whose access from an external device is invalid is set (detail code: 0005H).</li> <li>• The upper limit of the number of characters is exceeded (detail code: 0007H).</li> <li>• "Asynchronous" is set for the network synchronous communication setting of the device station referred to (detail code: 8002H).</li> <li>• An unsupported device is set (detail code: 8002H).</li> <li>• A device number out of range is set (detail code: 8002H).</li> </ul> <p>■ Signal detection method (Detection)<br/>The specification is allowed at the following level detection only.</p> <ul style="list-style-type: none"> <li>• 0: Detection at TRUE (HighLevel)</li> <li>• 1: Detection at FALSE (LowLevel)</li> </ul> <p>* If a value outside the range is set, Out of Parameter Range (Axis) (error code: 1A60H (detail code: 8003H)) occurs.</p> <p>■ Compensation time (CompensationTime)<br/>Ignores the input value.</p> <p>■ Filter time (FilterTime)<br/>The setting range is "0.0 to +5.0 [s]".</p> <p>* If a value outside the range is specified, Out of Filter Time Setting Range of Each Axis Signal Warning (event code: 00D24H) occurs, and the axis operates with 0.0 of the filter time.</p> |
| OperationCycle              | Control cycle setting             | At system start | INT                                                            | LIST_WRITE<br>_BACK | <p>The control operation cycle of the axis is set.</p> <p>■ Real axis<br/>An operation cycle equal to the communication cycle of the device station assigned to the axis is automatically selected.</p> <p>If no applicable operation cycle exists, Cycle Assignment Incorrect (Axis) (error code: 1B2BH) occurs.</p> <ul style="list-style-type: none"> <li>• 0: Automatic setting</li> </ul> <p>■ Virtual axis or real axis where no station address has been set</p> <ul style="list-style-type: none"> <li>• 0: Operate in the first operation cycle.</li> <li>• 1: Operate in the first operation cycle.</li> <li>• 2: Operate in the second operation cycle</li> <li>• 3: Operate in the third operation cycle</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| PosRestoration_AbsPosEnable | Absolute position control setting | At system start | INT<br>(MC_ABS_SYSTEM)<br>Page 1523<br>MC_ABS_SYSTEM           | LIST_WRITE<br>_BACK | <p>The absolute position control is set.</p> <ul style="list-style-type: none"> <li>• 0: Disable absolute position system (ABSDisabled)</li> <li>• 1: Enable absolute position system (Enabled)</li> <li>• -1: Automatic Setting (Acquire from Connected Device) (Auto)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

| Variable name                  | Name                                                    | Import          | Data type                                                                                                                                                   | Attribute           | Description                                                                                                                                                                         |
|--------------------------------|---------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PosRestoration_RestorationBase | Current position restoration reference position setting | At system start | INT<br>(MC_POS_RESTORATION_BASE)<br> Page 1525<br>MC_POS_RESTORATION_BASE  | LIST_WRITE<br>_BACK | When using the absolute position system, the current position restoration reference position is set.<br>• 0: Backup position<br>• 1: Home position<br>• -1: Automatic determination |
| RingCount_Enable               | Ring counter enabled selection                          | At system start | BOOL                                                                                                                                                        | LIST_WRITE<br>_BACK | Whether to enable/disable the ring counter is set.<br>• FALSE: Disabled<br>• TRUE: Enabled                                                                                          |
| RingCount_LowerValue           | Ring counter lower limit value                          | At system start | LREAL                                                                                                                                                       | LIST_WRITE<br>_BACK | The ring counter lower limit value is set.<br>• -100000000000.0 to 100000000000.0<br>* Not imported when the ring counter is disabled                                               |
| RingCount_UpperValue           | Ring counter upper limit value                          | At system start | LREAL                                                                                                                                                       | LIST_WRITE<br>_BACK | The ring counter upper limit value is set.<br>• -100000000000.0 to 100000000000.0<br>* Not imported when the ring counter is disabled                                               |
| SlaveEmulate_Enable            | Axis emulation enabled                                  | At system start | BOOL                                                                                                                                                        | LIST_WRITE<br>_BACK | Whether the axis is used as an emulate axis or not is set.<br>• FALSE: Disabled<br>• TRUE: Enabled                                                                                  |
| SlaveObject (for system)       | Object data                                             | At system start | SLAVE_OBJECT_REAL<br> Page 1504<br>SLAVE_OBJECT_REAL (for system)          | LIST_WRITE<br>_BACK | The object data is set to the real drive axis.<br>* Do not use this variable because it is for the system.                                                                          |
| SlaveObject                    | Object data                                             | At system start | SLAVE_OBJECT_VIRTUAL_ENCODER<br> Page 1506<br>SLAVE_OBJECT_VIRTUAL_ENCODER | LIST_WRITE<br>_BACK | The object data is set to the virtual encoder axis.                                                                                                                                 |
| TorqueLimit_Max                | Torque limit maximum value                              | At system start | LREAL                                                                                                                                                       | LIST_WRITE<br>_BACK | The maximum value that can be specified as the torque limit value is set. (Common in the positive direction and the negative direction)<br>• 0.0 to 1000.0 [%]                      |
| TorqueLimit_NegativeInitial    | Negative direction torque limit initial value           | At system start | LREAL                                                                                                                                                       | LIST_WRITE<br>_BACK | The initial value of Negative direction torque limit value ( <u>AxisName</u> .Cd.TorqueLimit_Negative) is set.<br>• 0.0 to 1000.0 [%]                                               |
| TorqueLimit_PositiveInitial    | Positive direction torque limit initial value           | At system start | LREAL                                                                                                                                                       | LIST_WRITE<br>_BACK | The initial value of Positive direction torque limit value ( <u>AxisName</u> .Cd.TorqueLimit_Positive) is set.<br>• 0.0 to 1000.0 [%]                                               |

**AxisName.Pr. (Axis parameter)**

| Variable name            | Name                                                     | Import   | Data type                                                                                                                                    | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------|----------------------------------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AccelerationLimit        | Acceleration limit value                                 | Ready ON | LREAL                                                                                                                                        | LIST_WRITE<br>_BACK | The acceleration limit value is set.<br><ul style="list-style-type: none"> <li>• 0.0000, 0.0001 to 2147483647.0 [U/s<sup>2</sup>]</li> </ul> <ul style="list-style-type: none"> <li>* When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it does not limit the acceleration.</li> <li>* When "0.0000" is set, it does not limit the acceleration.</li> <li>* When a positive number less than 0.0001 is set, the value is imported as "0.0000".</li> </ul> |
| AccelerationZeroBehavior | Operation selection at start acceleration/deceleration 0 | Ready ON | INT<br>(MC_ACC_ZERO_MODE)<br> Page 1524<br>MC_ACC_ZERO_MODE | LIST_WRITE<br>_BACK | The behavior when "0.0" is set as the acceleration, the deceleration, or the acceleration/deceleration time at start is set.<br><ul style="list-style-type: none"> <li>• -1: Error (Not started) (ACCErrror)</li> <li>• 1: Maximum acceleration/deceleration (MaximumAcceleration)</li> </ul>                                                                                                                                                                                                                               |
| CmdInPos_Width           | Command in-position width                                | Ready ON | LREAL                                                                                                                                        | LIST_WRITE<br>_BACK | The command in-position width is set.<br><ul style="list-style-type: none"> <li>• 0.0: Function disabled</li> <li>• 0.000000001 to 10000000000.0: Function enabled</li> </ul> <ul style="list-style-type: none"> <li>* When a positive number less than 0.000000001 is set, the value is imported as "0.0".</li> </ul>                                                                                                                                                                                                      |
| DecelerationLimit        | Deceleration limit value                                 | Ready ON | LREAL                                                                                                                                        | LIST_WRITE<br>_BACK | The deceleration limit value is set.<br><ul style="list-style-type: none"> <li>• 0.0000, 0.0001 to 2147483647.0 [U/s<sup>2</sup>]</li> </ul> <ul style="list-style-type: none"> <li>* When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it does not limit the acceleration.</li> <li>* When "0.0000" is set, it does not limit the deceleration.</li> <li>* When a positive number less than 0.0001 is set, the value is imported as "0.0000".</li> </ul> |
| Drive_UnitConvRatioNum   | Driver unit conversion numerator                         | Ready ON | DWORD(UDINT)                                                                                                                                 | LIST_WRITE<br>_BACK | The numerator used to convert the command unit of the motion system to the command unit of the drive unit is set.<br><ul style="list-style-type: none"> <li>• 1 to 2147483647</li> </ul>                                                                                                                                                                                                                                                                                                                                    |
| Drive_UnitConvRatioDen   | Driver unit conversion denominator                       | Ready ON | DWORD(UDINT)                                                                                                                                 | LIST_WRITE<br>_BACK | The denominator used to convert the command unit of the motion system to the command unit of the drive unit is set.<br><ul style="list-style-type: none"> <li>• 1 to 2147483647</li> </ul>                                                                                                                                                                                                                                                                                                                                  |

| Variable name     | Name                                 | Import   | Data type                                                        | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|--------------------------------------|----------|------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ForcedStop_Signal | Forced stop signal                   | Ready ON | SIGNAL_SELECT<br>☞ Page 1492<br>SIGNAL_SELECT<br>(Signal select) | LIST_WRITE<br>_BACK | <p>The signal to use the forced stop is set.</p> <p>It may be regarded as signal detection depending on the variable used as an external signal and the status of devices controlled by the controller. For details, refer to the following.</p> <p>Settings and operations specific to Forced stop signal (ForcedStop_Signal) are shown below.</p> <p>■I/O number (StartIO)<br/>Ignores the input value.</p> <p>■Target (Target)<br/>If Target is not specified, the signal is regarded as disabled and the signal non-detection status is always set.</p> <p>The data type that can be specified is only [VAR], [DEV], or [CONST].</p> <p>* If an unavailable value is set, Out of Parameter Range (Axis) (error code: 1A60H) occurs. The cause can be checked with the following detail codes.</p> <ul style="list-style-type: none"> <li>• An invalid string is set (detail code: 0001H).</li> <li>• An unusable data type is set (detail code: 0002H).</li> <li>• An unusable type is specified (detail code: 0003H).</li> <li>• A type other than a numeric type is specified when the label is specified (detail code: 0004H).</li> <li>• A non-existent signal is set (detail code: 0005H).</li> <li>• A global label whose access from an external device is invalid is set (detail code: 0005H).</li> <li>• The upper limit of the number of characters is exceeded (detail code: 0007H).</li> <li>• "Asynchronous" is set for the network synchronous communication setting of the device station referred to (detail code: 8002H).</li> <li>• An unsupported device is set (detail code: 8002H).</li> <li>• A device number out of range is set (detail code: 8002H).</li> </ul> <p>■Signal detection method (Detection)<br/>The specification is allowed at the following level detection only.</p> <ul style="list-style-type: none"> <li>• 0: Detection at TRUE (HighLevel)</li> <li>• 1: Detection at FALSE (LowLevel)</li> </ul> <p>* If edge detection specification is set, Out of Parameter Range (Axis) (error code: 1A60H) (detail code: 8003H) occurs.</p> <p>■Compensation time (CompensationTime)<br/>Ignores the input value.</p> <p>■Filter time (FilterTime)<br/>The setting range is "0.0 to 5.0 [s]".</p> <p>* If a value outside the range is specified, Out of Filter Time Setting Range of Each Axis Signal Warning (event code: 00D24H) occurs, and the axis operates with 0.0 of the filter time.</p> |
| Homing_Required   | Home position return required or not | Ready ON | BOOL                                                             | LIST_WRITE<br>_BACK | <p>Whether homing is required or not is set.</p> <p>When homing is not required, set this variable to FALSE. When set to FALSE, the homing request will not become TRUE at the current position restoration.</p> <ul style="list-style-type: none"> <li>• FALSE: Home position return not required</li> <li>• TRUE: Home position return required</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| JerkLimit         | Jerk limit value                     | Ready ON | LREAL                                                            | LIST_WRITE<br>_BACK | <p>The jerk limit value is set.</p> <ul style="list-style-type: none"> <li>• 0.0000, 0.0001 to 2147483647.0 [U/s<sup>3</sup>]</li> </ul> <p>* When "0.0000" is set, it does not limit the jerk.</p> <p>* When a positive number less than 0.0001 is set, the value is imported as "0.0000".</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| OverrunOperation  | Operation setting at overrun         | Ready ON | INT<br>(MC_DECEL_STOP_MODE)<br>☞ Page 1523<br>MC_DECEL_STOP_MODE | LIST_WRITE<br>_BACK | <p>The operation performed when the target position is exceeded during positioning operation is set.</p> <ul style="list-style-type: none"> <li>• 1: Immediate stop (ImmediateStop)</li> <li>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| Variable name                  | Name                                                     | Import   | Data type                                                        | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------|----------------------------------------------------------|----------|------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| StartableAtUnhomed             | Start permission at home position return uncompleted     | Ready ON | BOOL                                                             | LIST_WRITE<br>_BACK | Whether axis start is allowed or not when homing is incomplete is set.<br>• FALSE: Disabled<br>• TRUE: Enabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| StopMode_Deceleration          | Deceleration at stop                                     | Ready ON | LREAL                                                            | LIST_WRITE<br>_BACK | The deceleration/deceleration time at deceleration stop by stop cause occurrence is set.<br>■ When using acceleration/deceleration method specifying acceleration/deceleration (acceleration/deceleration specification method)<br>• 0.0000, 0.0001 to 2147483647.0 [U/s <sup>2</sup> ]<br>■ When using acceleration/deceleration method specifying acceleration/deceleration time (acceleration/deceleration time-fixed method)<br>• 0.000000, 0.000001 to 8400.0 [s]<br>* If this variable is set to "0.0", immediately stops regardless of the setting of Operation selection at start acceleration/deceleration 0 (AccelerationZeroBehavior)<br>* Clamp by the upper limit value when the upper limit value is out of the range at stop by factors, and handle as "0 (Immediate stop)" when lower limit value is out of the range. |
| StopMode_DecelerationCurve     | Stop selection at deceleration to stop                   | Ready ON | INT<br>(MC_STOP_CURVE_MODE)<br>☞ Page 1523<br>MC_STOP_CURVE_MODE | LIST_WRITE<br>_BACK | The operation performed when a stop cause occurs during deceleration (including a stop cause and automatic deceleration) is set.<br>• 1: Recreate deceleration curve (OverrideCurve)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| StopMode_General               | Stop selection at stop by factors                        | Ready ON | INT<br>(MC_DECEL_STOP_MODE)<br>☞ Page 1523<br>MC_DECEL_STOP_MODE | LIST_WRITE<br>_BACK | The operation performed when a stop cause occurs is set.<br>• 1: Immediate stop (ImmediateStop)<br>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)<br>• 3: Alternative acceleration/deceleration (AlternativeAcc)<br>* Immediate stop will be executed when executing an FB without deceleration specification.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| StopMode_HwStrokeLimit         | Stop selection at hardware stroke limit error occurrence | Ready ON | INT<br>(MC_DECEL_STOP_MODE)<br>☞ Page 1523<br>MC_DECEL_STOP_MODE | LIST_WRITE<br>_BACK | The operation performed when a hardware stroke limit error occurs is set.<br>• 1: Immediate stop (ImmediateStop)<br>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)<br>• 3: Alternative acceleration/deceleration (AlternativeAcc)<br>* Immediate stop will be executed when executing an FB without deceleration specification.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| StopMode_ServoOff              | Process selection at servo OFF command during operation  | Ready ON | INT<br>(MC_DECEL_STOP_MODE)<br>☞ Page 1523<br>MC_DECEL_STOP_MODE | LIST_WRITE<br>_BACK | The operation performed when the servo OFF state is established during operation is set.<br>• 0: Ignore (Ignore)<br>• 4: Servo OFF after immediate stop (ServoOffAfterImmediateStop)<br>• 5: Servo OFF after deceleration to stop (ServoOffAfterDecelStop)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| StopMode_SwStrokeLimit         | Stop selection at software stroke limit error occurrence | Ready ON | INT<br>(MC_DECEL_STOP_MODE)<br>☞ Page 1523<br>MC_DECEL_STOP_MODE | LIST_WRITE<br>_BACK | The operation performed when a software stroke limit error occurs is set.<br>• 1: Immediate stop (ImmediateStop)<br>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)<br>• 3: Alternative acceleration/deceleration (AlternativeAcc)<br>* Immediate stop will be executed when executing an FB without deceleration specification.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| StopOption_DriverTargetIgnored | Driver command discard detection setting                 | Ready ON | BOOL                                                             | LIST_WRITE<br>_BACK | Whether to detect the command discard status of the driver module and stop at an error during operation of the axis or not is set.<br>• FALSE: Detection disabled<br>• TRUE: Detection enabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

| Variable name        | Name                              | Import   | Data type                                                        | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------|-----------------------------------|----------|------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| StopSignal           | Stop signal                       | Ready ON | SIGNAL_SELECT<br>☞ Page 1492<br>SIGNAL_SELECT<br>(Signal select) | LIST_WRITE<br>_BACK | <p>The signal to use the stop signal (STOP) of the external input signal is set.</p> <p>It may be regarded as signal detection depending on the variable used as an external signal and the status of devices controlled by the controller.</p> <p>Settings and operations specific to Stop signal (StopSignal) are shown below.</p> <p>■I/O number (StartIO)<br/>Ignores the input value.</p> <p>■Target (Target)<br/>If Target is not specified, the signal is regarded as disabled and the signal non-detection status is always set.</p> <p>The data type that can be specified is only [VAR], [DEV], or [CONST].</p> <p>* If an unavailable value is set, Out of Parameter Range (Axis) (error code: 1A60H) occurs. The cause can be checked with the following detail codes.</p> <ul style="list-style-type: none"> <li>• An invalid string is set (detail code: 0001H).</li> <li>• An unusable data type is set (detail code: 0002H).</li> <li>• An unusable type is specified (detail code: 0003H).</li> <li>• A type other than a numeric type is specified when the label is specified (detail code: 0004H).</li> <li>• A non-existent signal is set (detail code: 0005H).</li> <li>• A global label whose access from an external device is invalid is set (detail code: 0005H).</li> <li>• The upper limit of the number of characters is exceeded (detail code: 0007H).</li> <li>• "Asynchronous" is set for the network synchronous communication setting of the device station referred to (detail code: 8002H).</li> <li>• An unsupported device is set (detail code: 8002H).</li> <li>• A device number out of range is set (detail code: 8002H).</li> </ul> <p>■Signal detection method (Detection)<br/>The specification is allowed at the following level detection only.</p> <ul style="list-style-type: none"> <li>· 0: Detection at TRUE (HighLevel)</li> <li>· 1: Detection at FALSE (LowLevel)</li> </ul> <p>* If edge detection specification is set, Out of Parameter Range (Axis) (error code: 1A60H) (detail code: 8003H) occurs.</p> <p>■Compensation time (CompensationTime)<br/>Ignores the input value.</p> <p>■Filter time (FilterTime)<br/>The setting range is "0.0 to 5.0 [s]".</p> <p>* If a value outside the range is specified, Out of Filter Time Setting Range of Each Axis Signal Warning (event code: 00D24H) occurs, and the axis operates with 0.0 of the filter time.</p> |
| SwStrokeLimit_Lower  | Software stroke limit lower value | Ready ON | LREAL                                                            | LIST_WRITE<br>_BACK | <p>The software stroke limit lower value is set.</p> <ul style="list-style-type: none"> <li>• -10000000000.0 to 10000000000.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| SwStrokeLimit_Target | Software stroke limit target      | Ready ON | INT<br>(MC_POS_SOURCE)<br>☞ Page 1524<br>MC_POS_SOURCE           | LIST_WRITE<br>_BACK | <p>The target of the software stroke limit is set.</p> <ul style="list-style-type: none"> <li>• -1: Invalid (Invalid)</li> <li>• 1: Set position (SetPosition)</li> <li>• 3: Feed machine position (FeedMachinePosition)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| SwStrokeLimit_Upper  | Software stroke limit upper value | Ready ON | LREAL                                                            | LIST_WRITE<br>_BACK | <p>The software stroke limit upper value is set.</p> <ul style="list-style-type: none"> <li>• -10000000000.0 to 10000000000.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

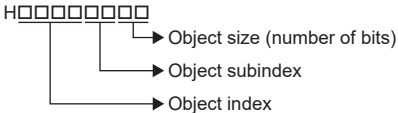
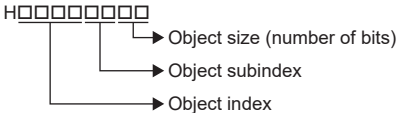
| Variable name               | Name                                            | Import   | Data type                                                                                                                                                  | Attribute       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------|-------------------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Unit_Position               | Position command unit                           | Ready ON | DWORD(HEX)                                                                                                                                                 | LIST_WRITE_BACK | The position command unit to be used in the motion control is set.<br><ul style="list-style-type: none"> <li>• 00000000H: pulse</li> <li>• 00010000H: m</li> <li>• FD010000H: mm</li> <li>• FA010000H: <math>\mu</math>m</li> <li>• F7010000H: nm</li> <li>• 00410000H: degree</li> <li>• FD410000H: <math>\times 10^{-3}</math>degree</li> <li>• FA410000H: <math>\times 10^{-6}</math>degree</li> <li>• 00B40000H: Revolution</li> <li>• 00C00000H: inch</li> <li>• 00FF0000H: An arbitrary unit</li> </ul>                                                                                                                                                                                             |
| Unit_PositionString         | Position command unit string                    | Ready ON | WSTRING(31)                                                                                                                                                | LIST_WRITE_BACK | The command unit to be used in the motion control is set as a string.<br>This variable is set when Position Command Unit (AxisName.Pr.Unit_Position) is set to "00FF0000H: An arbitrary unit".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Unit_Velocity               | Velocity command unit                           | Ready ON | DWORD(HEX)                                                                                                                                                 | LIST_WRITE_BACK | The velocity command unit to be used in the motion control is set.<br><ul style="list-style-type: none"> <li>• 00000300H: U/s</li> <li>• 00004700H: U/min</li> <li>• FD000300H: U/ms</li> <li>• FA000300H: U/<math>\mu</math>s</li> <li>• F7000300H: U/ns</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| VelocityBias                | Speed bias value                                | Ready ON | LREAL                                                                                                                                                      | LIST_WRITE_BACK | The speed bias value is set for each axis.<br><ul style="list-style-type: none"> <li>• 0.0000, 0.0001 to 2500000000.0</li> </ul> When "0.0000" is set, the speed bias is invalid.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| VelocityLimit_Negative      | Negative direction speed limit value            | Ready ON | LREAL                                                                                                                                                      | LIST_WRITE_BACK | The negative direction speed limit value is set.<br><ul style="list-style-type: none"> <li>• 0.0001 to 2500000000.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| VelocityLimit_OverOperation | Operation setting at speed limit value exceeded | Ready ON | INT<br>(MC_VELOCITY_LIMIT_MODE)<br> Page 1522<br>MC_VELOCITY_LIMIT_MODE | LIST_WRITE_BACK | The operation performed when the speed limit value is exceeded is set.<br><ul style="list-style-type: none"> <li>• 0: Ignore (Ignore)</li> <li>• 3: Immediate stop (ImmediateStop)</li> </ul> * When "0: Ignore (Ignore)" is set, Speed Limit Value Over Warning (event code: 00D03H) occurs at the time of detecting the command velocity exceeding the speed limit value, and the command exceeding the speed limit value is output as it is.<br>* When "3: Immediate stop (ImmediateStop)" is set, Speed Limit Value Over during Controlling (error code: 1AA4H) occurs at the time of detecting the command velocity exceeding the speed limit value, and the positioning control in execution stops. |
| VelocityLimit_Positive      | Positive direction speed limit value            | Ready ON | LREAL                                                                                                                                                      | LIST_WRITE_BACK | The positive direction speed limit value is set.<br><ul style="list-style-type: none"> <li>• 0.0001 to 2500000000.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

### AxisName.Md. (Axis monitor data)

| Variable name            | Name                                                     | Import          | Data type                                                                                                                                      | Attribute      | Description                                                                                                                                                                                                                                                                                        |
|--------------------------|----------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AccelerationLimit        | Acceleration limit value                                 | Ready ON        | LREAL                                                                                                                                          | LIST_READ_ONLY | The acceleration limit value is stored.                                                                                                                                                                                                                                                            |
| AccelerationOverride     | Acceleration override factor                             | Operation cycle | LREAL                                                                                                                                          | LIST_READ_ONLY | The acceleration override factor is stored.                                                                                                                                                                                                                                                        |
| AccelerationZeroBehavior | Operation selection at start acceleration/deceleration 0 | Ready ON        | INT<br>(MC_ACC_ZERO_MODE)<br> Page 1524<br>MC_ACC_ZERO_MODE | LIST_READ_ONLY | The behavior when "0.0" is set as the acceleration, the deceleration, or the acceleration/deceleration time at start is displayed.<br><ul style="list-style-type: none"> <li>• -1: Error (Not started) (ACCError)</li> <li>• 1: Maximum acceleration/deceleration (MaximumAcceleration)</li> </ul> |
| ActualPosition           | Actual position                                          | Operation cycle | LREAL                                                                                                                                          | LIST_READ_ONLY | The actual current position is stored.<br>The value of "The actual position = the current position $\times$ driver unit conversion denominator/numerator" is set.<br>The actual position is a value which is rounded with the ring counter range.                                                  |

| Variable name         | Name                       | Import           | Data type                                                                                                                                | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------|----------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ActualVelocity        | Actual velocity            | Operation cycle  | LREAL                                                                                                                                    | LIST_READ_ONLY | The actual velocity is stored.<br>This velocity is calculated from the difference of the actual position.<br>The value is positive when moving to the positive direction (Address increase direction), and the value is negative when moving to the negative direction (Address decrease direction).                                                                                                                                                                                                                                                                    |
| Analyzing             | Analyzing                  | Operation cycle  | BOOL                                                                                                                                     | LIST_READ_ONLY | The status of positioning analyzing is displayed.<br>• FALSE: Not analyzing<br>• TRUE: Analyzing                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| AutoDeceleration      | Automatically decelerating | Operation cycle  | BOOL                                                                                                                                     | LIST_READ_ONLY | The auto deceleration processing status is displayed.<br>TRUE is stored while the auto deceleration processing is performed.<br>When the multiple start is performed, TRUE is set while the auto deceleration processing is executed during the last positioning point execution.<br>FALSE is set when the control change is performed.<br>During axes group operation, FALSE is stored in Automatically decelerating ( <u>AxisName</u> .Md.AutoDeceleration) of the configuration axis.<br>• FALSE: Not during auto deceleration<br>• TRUE: Automatically decelerating |
| AxisName              | Axis name                  | At system start  | WSTRING(127)                                                                                                                             | LIST_READ_ONLY | The axis name is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| AxisStatus            | Axis status                | Operation cycle  | INT<br>(MC_AXIS_STATUS)<br> Page 1521<br>MC_AXIS_STATUS | LIST_READ_ONLY | The axis status is displayed.<br>• -1: Axis variable not initialized/axis parameter error (Invalid)<br>• 0: Axis disabled (Disabled)<br>• 1: Stopping on error (ErrorStop)<br>• 2: Decelerating to stop (Stopping)<br>• 3: During homing (Homing)<br>• 4: Standby (Standstill)<br>• 5: During positioning operation (DiscreteMotion)<br>• 6: During continuous operation (ContinuousMotion)<br>• 7: During synchronous operation (SynchronizedMotion)                                                                                                                   |
| BufferingFBs          | Number of buffering FBs    | At start/at stop | INT                                                                                                                                      | LIST_READ_ONLY | Displays the number of buffering FBs (0 to 2).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| CmdInPos              | Command in-position        | Operation cycle  | BOOL                                                                                                                                     | LIST_READ_ONLY | This signal turns on when the remaining distance to the target position becomes equal to or less than Command in-position width ( <u>AxisName</u> .Md.CmdInPos_Width).<br>• TRUE: Equal to or less than Command in-position width<br>• FALSE: More than Command in-position width                                                                                                                                                                                                                                                                                       |
| CmdInPos_Width        | Command in-position width  | Ready ON         | LREAL                                                                                                                                    | LIST_READ_ONLY | The command in-position width is displayed.<br>Imports the setting value of Command in-position width ( <u>AxisName</u> .Pr.CmdInPos_Width).<br>When Command in-position width ( <u>AxisName</u> .Md.CmdInPos_Width) is set to "0.0", the command in-position function of the axis is disabled.                                                                                                                                                                                                                                                                         |
| CommandedAcceleration | Specified acceleration     | Operation cycle  | LREAL                                                                                                                                    | LIST_READ_ONLY | The acceleration specified by the user is stored. (Unit: U/s <sup>2</sup> )<br>When the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)", this variable stores the specified acceleration/deceleration time. (Unit: s)<br>During axes group operation, "0.0" is stored in Specified acceleration ( <u>AxisName</u> .Md.CommandedAcceleration) of the configuration axis.                                                                                                                                       |
| CommandedDeceleration | Specified deceleration     | Operation cycle  | LREAL                                                                                                                                    | LIST_READ_ONLY | The deceleration specified by the user is stored. (Unit: U/s <sup>2</sup> ) When the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)", it is an illegal value. During axes group operation, "0.0" is stored in Specified deceleration ( <u>AxisName</u> .Md.CommandedDeceleration) of the configuration axis.                                                                                                                                                                                                  |



| Variable name          | Name                                          | Import                 | Data type                                                                                                                                | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------|-----------------------------------------------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CommandedJerk          | Specified jerk                                | Operation cycle        | LREAL                                                                                                                                    | LIST_READ_ONLY | The jerk specified by the user is stored. (Unit: U/s <sup>3</sup> )<br>During axes group operation, "0.0" is stored in Specified jerk ( <u>AxisName</u> .Md.CommandedJerk) of the configuration axis.                                                                                                                                                                                                                                       |
| CommandedPosition      | Commanded position                            | Operation cycle        | LREAL                                                                                                                                    | LIST_READ_ONLY | The Target position (Position) and Movement amount (Distance) set in the positioning motion control FB being controlled is stored.<br>"0.0" is stored after the positioning is completed.                                                                                                                                                                                                                                                   |
| CommandedVelocity      | Commanded velocity                            | Operation cycle        | LREAL                                                                                                                                    | LIST_READ_ONLY | The commanded velocity imported to the motion related motion control FB being controlled is stored.<br>"0.0" is stored after the control is completed.<br>During axes group operation, "0.0" is stored in Commanded velocity ( <u>AxisName</u> .Md.CommandedVelocity) of the configuration axis.                                                                                                                                            |
| Cst_SetTorque          | Set torque at cst/ct                          | Operation cycle        | LREAL                                                                                                                                    | LIST_READ_ONLY | The set torque for cyclic torque mode (cst)/continuous operation to torque control mode (ct) is stored.                                                                                                                                                                                                                                                                                                                                     |
| Cst_TargetTorque       | Target torque at cst/ct                       | Operation cycle        | LREAL                                                                                                                                    | LIST_READ_ONLY | The target torque for cyclic torque mode (cst)/continuous operation to torque control mode (ct) is stored.                                                                                                                                                                                                                                                                                                                                  |
| CumulativePosition     | Cumulative current position                   | Operation cycle        | LREAL                                                                                                                                    | LIST_READ_ONLY | The current position address is stored.<br>When the current position is changed, the address is changed to the current position change value.<br>The ring address is "-10000000000.0 ≤ cumulative current position < 10000000000.0".                                                                                                                                                                                                        |
| DecelerationLimit      | Deceleration limit value                      | Ready ON               | LREAL                                                                                                                                    | LIST_READ_ONLY | The deceleration limit value is stored.                                                                                                                                                                                                                                                                                                                                                                                                     |
| Drive_RPDO[1..64]      | RPDO (Motion system → Device station) mapping | When connecting device | DWORD(HEX)                                                                                                                               | LIST_READ_ONLY | In the RPDO mapping settings of the network parameter, the object index specified to the nth place is displayed.<br> <ul style="list-style-type: none"> <li>• The object size displays 1 byte, 2 bytes, 4 bytes, and 8 bytes in bits.</li> <li>• When the size of the nth object is 1 byte, a padding object is inserted in the nth+1 place.</li> </ul> |
| Drive_TPDO[1..64]      | TPDO (Device → Motion system) mapping         | When connecting device | DWORD(HEX)                                                                                                                               | LIST_READ_ONLY | In the TPDO mapping settings of the network parameter, the object index specified to the nth place is displayed.<br> <ul style="list-style-type: none"> <li>• The object size displays 1 byte, 2 bytes, 4 bytes, and 8 bytes in bits.</li> <li>• When the size of the nth object is 1 byte, a padding object is inserted in the nth+1 place.</li> </ul> |
| Drive_UnitConvRatioNum | Driver unit conversion numerator              | Ready ON               | DWORD(UDINT)                                                                                                                             | LIST_READ_ONLY | The numerator used to convert to the command unit of the drive unit is stored.                                                                                                                                                                                                                                                                                                                                                              |
| Drive_UnitConvRatioDen | Driver unit conversion denominator            | Ready ON               | DWORD(UDINT)                                                                                                                             | LIST_READ_ONLY | The denominator used to convert to the command unit of the drive unit is stored.                                                                                                                                                                                                                                                                                                                                                            |
| Driver_Mode            | Driver control mode                           | Operation cycle        | INT<br>(MC_DRIVE_MODE)<br> Page 1522<br>MC_DRIVE_MODE | LIST_READ_ONLY | Control mode status of the drive unit is displayed. <ul style="list-style-type: none"> <li>• 6: Homing mode (hm)</li> <li>• 8: Cyclic synchronous position mode (csp)</li> <li>• 9: Cyclic synchronous velocity mode (csv)</li> <li>• 10: Cyclic synchronous torque mode (cst)</li> <li>• -104: Continuous operation to torque control mode (ct)</li> </ul>                                                                                 |

| Variable name          | Name                         | Import          | Data type                                                                                                                                | Attribute      | Description                                                                                                                                                                                                                                                                                  |
|------------------------|------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Driver_ReadyOn         | Driver ready ON status       | Operation cycle | BOOL                                                                                                                                     | LIST_READ_ONLY | The status of the connected drive unit is displayed.<br>This variable becomes TRUE when Driver status (AxisName.Md.Driver_State) is set to one of the following.<br>• 2: Fault Reaction Active<br>• 5: Switched On<br>• 6: Operation Enable<br>• 7: Quick Stop Active                        |
| Driver_ServoOn         | Driver servo ON status       | Operation cycle | BOOL                                                                                                                                     | LIST_READ_ONLY | The status of the connected drive unit is displayed.<br>This variable becomes TRUE when Driver status (AxisName.Md.Driver_State) is set to one of the following.<br>• 6: Operation Enable<br>• 7: Quick Stop Active                                                                          |
| Driver_State           | Driver status                | Operation cycle | INT<br>(MC_DRIVE_STATE)<br> Page 1523<br>MC_DRIVE_STATE | LIST_READ_ONLY | The drive unit status is displayed.<br>• 0: Not Ready To Switch On<br>• 1: Fault<br>• 2: Fault Reaction Active<br>• 3: Switch On Disabled<br>• 4: Ready To Switch On<br>• 5: Switched On<br>• 6: Operation Enable<br>• 7: Quick Stop Active<br>• -1: Invalid                                 |
| DriverError            | Drive unit error detection   | Immediately     | BOOL                                                                                                                                     | LIST_READ_ONLY | The drive unit error status is displayed.<br>• FALSE: No drive unit error<br>• TRUE: Drive unit error present                                                                                                                                                                                |
| DriverErrorID          | Drive unit error code        | Immediately     | WORD(HEX)                                                                                                                                | LIST_READ_ONLY | The upper 16 bits of "Current alarm (2A41H)" of the object data is displayed when a drive unit error occurs.                                                                                                                                                                                 |
| DriverErrorDetailID    | Drive unit error detail code | Immediately     | WORD(HEX)                                                                                                                                | LIST_READ_ONLY | Stores the lower 16 bits of "Current alarm (2A41H)" of the object data at drive unit error occurrence.                                                                                                                                                                                       |
| Encoder_Connected      | Connection status            | Operation cycle | BOOL                                                                                                                                     | LIST_READ_ONLY | The virtual encoder axis connection status is displayed.<br>• FALSE: Not connected<br>• TRUE: Connected                                                                                                                                                                                      |
| Encoder_CounterDisable | Counter disabled             | Operation cycle | BOOL                                                                                                                                     | LIST_READ_ONLY | The status of the input from the encoder is displayed.<br>• FALSE: Counter enabled<br>• TRUE: Counter disabled                                                                                                                                                                               |
| Error                  | Axis error detection         | Immediately     | BOOL                                                                                                                                     | LIST_READ_ONLY | The axis error status is displayed.<br>• FALSE: No axis error<br>• TRUE: Axis error present                                                                                                                                                                                                  |
| ErrorID                | Axis error code              | Immediately     | WORD(HEX)                                                                                                                                | LIST_READ_ONLY | The error code of the axis error occurred is displayed.                                                                                                                                                                                                                                      |
| FeedMachinePosition    | Feed machine position        | Operation cycle | LREAL                                                                                                                                    | LIST_READ_ONLY | The current position address by the machine coordinate is stored.<br>The cumulative value from the homing complete position is set.<br>The address is not changed even if the current position is changed.<br>The ring address is "-10000000000.0 ≤ feed function position < 10000000000.0". |
| FollowupDisable        | Follow-up disabled           | Operation cycle | BOOL                                                                                                                                     | LIST_READ_ONLY | The follow-up disable status is displayed.<br>When it is disabled, the follow-up is not performed.<br>• FALSE: Follow-up enabled<br>• TRUE: Follow-up disabled                                                                                                                               |
| ForcedStop_Release     | Forced stop cancelling       | Operation cycle | BOOL                                                                                                                                     | LIST_READ_ONLY | The forced stop cancel status is displayed.<br>• FALSE: Forced stop<br>• TRUE: Forced stop release                                                                                                                                                                                           |

| Variable name            | Name                                  | Import          | Data type                                                                                                                                        | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------|---------------------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ForcedStop_Signal        | Forced stop signal                    | Ready ON        | SIGNAL_SELECT<br> Page 1492<br>SIGNAL_SELECT<br>(Signal select) | LIST_READ_ONLY | The input status of the forced stop signal is displayed.<br>Outputs specific to Forced stop signal (ForcedStop_Signal) are shown below.<br>■ I/O number (StartIO)<br>"0" is always displayed.<br>■ Target (Target)<br>The fetch result of the parameter is displayed.<br>■ Signal detection method (Detection)<br>The fetch result of the parameter is displayed.<br>■ Compensation time (CompensationTime)<br>"0.0" is always displayed.<br>■ Filter time (FilterTime)<br>The fetch result of the parameter is displayed. |
| Homing_Complete          | Home position return completed        | Immediately     | BOOL                                                                                                                                             | LIST_READ_ONLY | Whether homing is completed normally or not is displayed.<br>This variable becomes FALSE when operation starts or when homing is required.<br>• FALSE: Homing uncompleted<br>• TRUE: Home position return completed                                                                                                                                                                                                                                                                                                        |
| Homing_Request           | Home position return request          | Immediately     | BOOL                                                                                                                                             | LIST_READ_ONLY | Whether homing is required or not is displayed.<br>This variable becomes FALSE when homing is completed.<br>• FALSE: No homing request<br>• TRUE: Homing request                                                                                                                                                                                                                                                                                                                                                           |
| Homing_Required          | Home position return required or not  | Ready ON        | BOOL                                                                                                                                             | LIST_READ_ONLY | Whether homing is required for the axis or not is displayed.<br>If set to FALSE, the homing request will not become TRUE at the current position restoration.<br>• FALSE: Home position return not required<br>• TRUE: Home position return required                                                                                                                                                                                                                                                                       |
| Homing_Status            | Home position return operation status | Operation cycle | WORD(HEX)                                                                                                                                        | LIST_READ_ONLY | The homing status of the drive unit is displayed.<br>• 0000H: Homing procedure in progress<br>• 0001H: Homing procedure interrupted or not started<br>• 0002H: Homing attained (target not reached)<br>• 0003H: Homing procedure completed successfully<br>• 0004H: Homing error occurred (velocity other than 0)<br>• 0005H: Homing error occurred (velocity is 0)<br>• FFFFH: Homing procedure is not in progress                                                                                                        |
| HwStrokeLimit_Fls Status | Upper limit signal status             | Operation cycle | BOOL                                                                                                                                             | LIST_READ_ONLY | The detection status of the upper limit signal (FLS) is displayed.<br>• FALSE: Not detecting the upper limit signal (FLS)<br>• TRUE: Detecting the upper limit signal (FLS)<br>* Displays the detection state which reflects the signal detection method or the filter time but not the signal input state.                                                                                                                                                                                                                |
| HwStrokeLimit_Ov erride  | Hardware stroke limit override        | At start        | STRING(15)                                                                                                                                       | LIST_READ_ONLY | The acceptance status of the enabled/disabled switching command of the hardware stroke limit check is displayed.<br>• DISABLE: Check disabled<br>• ONLY_INSIDE: Check disabled for movement returning to the range<br>• Others: No disable request                                                                                                                                                                                                                                                                         |
| HwStrokeLimit_Rls Status | Lower limit signal status             | Operation cycle | BOOL                                                                                                                                             | LIST_READ_ONLY | The detection status of the lower limit signal (RLS) is displayed.<br>• FALSE: Not detecting the lower limit signal (RLS)<br>• TRUE: Detecting the lower limit signal (RLS)<br>* Displays the detection state which reflects the signal detection method or the filter time but not the signal input state.                                                                                                                                                                                                                |
| InVelocity               | Target velocity reached               | Operation cycle | BOOL                                                                                                                                             | LIST_READ_ONLY | Whether the set velocity has reached to the target velocity or not is displayed.<br>During axes group operation, FALSE is displayed in Target velocity reached ( <u>AxisName</u> .Md.InVelocity) of the configuration axis.<br>• FALSE: Not reached<br>• TRUE: Reached                                                                                                                                                                                                                                                     |

| Variable name           | Name                                | Import          | Data type                                                                                                                                                        | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------|-------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Io_PosActualValue       | Object data_PosActualValue          | Operation cycle | DINT                                                                                                                                                             | LIST_READ_ONLY | The value of object data "Position actual value" (6064H) is displayed. (The feedback of position to be received from the device station)<br>For a real encoder axis or virtual encoder axis, the input pulse value [encoder pulse unit] acquired from the encoder is displayed.                                                                                                                                                                                                                                                                                                        |
| Io_PosEncoderResolution | Object data_PosEncoderResolution    | Operation cycle | DWORD(UDINT)                                                                                                                                                     | LIST_READ_ONLY | The value of object data "Position encoder resolution" (608FH) is displayed.<br>For a real encoder axis or virtual encoder axis, the synchronous encoder resolution is displayed.                                                                                                                                                                                                                                                                                                                                                                                                      |
| Io_Statusword           | Object data_Statusword              | Operation cycle | WORD(HEX)                                                                                                                                                        | LIST_READ_ONLY | The value of object data "Statusword" (6041H) is displayed.<br>For a real encoder axis, the encoder status is emulated and displayed on the motion system side.                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Io_TargetPos            | Object data_TargetPos               | Operation cycle | DINT                                                                                                                                                             | LIST_READ_ONLY | The value of object data "Target position" (607AH) is displayed. (The position command to be sent to the device station)<br>For a virtual drive axis, a value which is converted into the command value in a driver unit from the cumulative current position is displayed.                                                                                                                                                                                                                                                                                                            |
| Io_TargetVelocity       | Object data_TargetVelocity          | Operation cycle | DINT                                                                                                                                                             | LIST_READ_ONLY | The value of object data "Target Velocity" (60FFH) is displayed. (The velocity command to be sent to the device station)                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Io_TorqueActualValue    | Object data_TorqueActualValue       | Operation cycle | INT                                                                                                                                                              | LIST_READ_ONLY | The value of object data "Torque actual value" (6077H) is displayed. (The actual torque to be received from the device station)                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Io_VelActualValue       | Object data_VelActualValue          | Operation cycle | DINT                                                                                                                                                             | LIST_READ_ONLY | The value of object data "Velocity actual value" (606CH) is displayed. (The actual velocity to be received from the device station)                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| JerkLimit               | Jerk limit value                    | Ready ON        | LREAL                                                                                                                                                            | LIST_READ_ONLY | The jerk limit value is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| OperationCycle          | Control cycle                       | At system start | INT                                                                                                                                                              | LIST_READ_ONLY | The control operation cycle of the axis is stored.<br><ul style="list-style-type: none"> <li>• 0: Axis not initialized/Control cycle setting out-of-range</li> <li>• 1: Operate in the first operation cycle</li> <li>• 2: Operate in the second operation cycle</li> <li>• 3: Operate in the third operation cycle</li> </ul>                                                                                                                                                                                                                                                         |
| OverrunOperation        | Operation setting at overrun        | Ready ON        | INT<br>(MC_DECEL_STOP_MODE)<br> Page 1523<br>MC_DECEL_STOP_MODE               | LIST_READ_ONLY | The input status of the overrun operation setting is displayed.<br><ul style="list-style-type: none"> <li>• 1: Immediate stop (ImmediateStop)</li> <li>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)</li> </ul>                                                                                                                                                                                                                                                                                                                                                         |
| PosRestoration_Status   | Current position restoration status | Service         | INT<br>(MC_POS_RESTORATION_STATUS)<br> Page 1524<br>MC_POS_RESTORATION_STATUS | LIST_READ_ONLY | The current position restoration status is displayed.<br><ul style="list-style-type: none"> <li>• 0: Not Executed (NotExecute)</li> <li>• 1: Waiting for Restoration Request (WaitingRequest)</li> <li>• 2: Restoration Completed in Incremental System (RestoredInIncSystem)</li> <li>• 3: Restoration Completed in Absolute Position System (Homing Uncompleted) (RestoredInAbsSystemUnHomed)</li> <li>• 4: Restoration Completed in Absolute Position System (RestoredInAbsSystem)</li> </ul> <p>* "0: Not Executed (NotExecute)" is displayed when the device is disconnected.</p> |
| ProfileID               | Execution profile ID No.            | Operation cycle | WORD(UINT)                                                                                                                                                       | LIST_READ_ONLY | The profile ID currently being executed is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| Variable name              | Name                                                     | Import          | Data type                                                                                                                                          | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------|----------------------------------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SetAcceleration            | Set current acceleration                                 | Operation cycle | LREAL                                                                                                                                              | LIST_READ_ONLY | <p>The set output acceleration (the acceleration/deceleration calculated from the difference of the set velocity) is stored.*1 (Unit: U/s<sup>2</sup>)</p> <p>The acceleration/deceleration status will vary depending on the movement direction and the value of Set Acceleration (AxisName.Md.SetAcceleration).</p> <p>■Positive movement direction (address increasing direction)</p> <ul style="list-style-type: none"> <li>• 0.0: During stop or fixed-speed</li> <li>• Positive value: Being accelerated</li> <li>• Negative value: Being decelerated</li> </ul> <p>■Negative movement direction (address decreasing direction)</p> <ul style="list-style-type: none"> <li>• 0.0: During stop or fixed-speed</li> <li>• Positive value: Being decelerated</li> <li>• Negative value: Being accelerated</li> </ul> <p>"0.0" is stored when the target velocity is reached.</p> <p>During axes group operation, the set acceleration of the configuration axis is stored.</p> |
| SetPosition                | Set position                                             | Operation cycle | LREAL                                                                                                                                              | LIST_READ_ONLY | <p>The current position address is stored.*1</p> <p>The set position is a value equal to the cumulative current value rounded with the ring counter range.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| SetVelocity                | Set velocity                                             | Operation cycle | LREAL                                                                                                                                              | LIST_READ_ONLY | <p>The set output velocity is stored.*1</p> <p>This velocity is calculated from the difference of the set position.</p> <p>The value is positive when moving to the positive direction (Address increase direction), and the value is negative when moving to the negative direction (Address decrease direction).</p> <p>During axes group operation, the set velocity of the configuration axis is stored.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| SlaveEmulate_Enabled       | Axis emulating                                           | Service         | BOOL                                                                                                                                               | LIST_READ_ONLY | <p>Whether driver emulate operation is valid or invalid is displayed.</p> <ul style="list-style-type: none"> <li>• FALSE: Disabled</li> <li>• TRUE: Enabled</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| StartableAtUnhomed         | Start permission at home position return uncompleted     | Ready ON        | BOOL                                                                                                                                               | LIST_READ_ONLY | <p>The start status when homing is incomplete is displayed.</p> <ul style="list-style-type: none"> <li>• FALSE: Disabled</li> <li>• TRUE: Enabled</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| StopMode_Deceleration      | Deceleration at stop                                     | Ready ON        | LREAL                                                                                                                                              | LIST_READ_ONLY | <p>The input status of deceleration at stop is displayed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| StopMode_DecelerationCurve | Stop selection at deceleration to stop                   | Ready ON        | INT<br>(MC_STOP_CURVE_MODE)<br> Page 1523<br>MC_STOP_CURVE_MODE | LIST_READ_ONLY | <p>The input status of stop selection at deceleration to stop is displayed.</p> <ul style="list-style-type: none"> <li>• 1: Recreate deceleration curve (OverrideCurve)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| StopMode_General           | Stop selection at stop by factors                        | Ready ON        | INT<br>(MC_DECEL_STOP_MODE)<br> Page 1523<br>MC_DECEL_STOP_MODE | LIST_READ_ONLY | <p>The input status of stop selection at stop by factors is displayed.</p> <ul style="list-style-type: none"> <li>• 1: Immediate stop (ImmediateStop)</li> <li>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)</li> <li>• 3: Alternative acceleration/deceleration (AlternativeAcc)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| StopMode_HwStrokeLimit     | Stop selection at hardware stroke limit error occurrence | Ready ON        | INT<br>(MC_DECEL_STOP_MODE)<br> Page 1523<br>MC_DECEL_STOP_MODE | LIST_READ_ONLY | <p>The input status of stop selection at the hardware stroke limit error occurrence is displayed.</p> <ul style="list-style-type: none"> <li>• 1: Immediate stop (ImmediateStop)</li> <li>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)</li> <li>• 3: Alternative acceleration/deceleration (AlternativeAcc)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| StopMode_ServoOff          | Process selection at servo OFF command during operation  | Ready ON        | INT<br>(MC_DECEL_STOP_MODE)<br> Page 1523<br>MC_DECEL_STOP_MODE | LIST_READ_ONLY | <p>The input status of process selection at servo OFF command during operation is displayed.</p> <ul style="list-style-type: none"> <li>• 0: Ignore (Ignore)</li> <li>• 4: Servo OFF after immediate stop (ServoOffAfterImmediateStop)</li> <li>• 5: Servo OFF after deceleration to stop (ServoOffAfterDecelStop)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| Variable name                  | Name                                                     | Import          | Data type                                                                                                                                        | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------|----------------------------------------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| StopMode_SwStrokeLimit         | Stop selection at software stroke limit error occurrence | Ready ON        | INT<br>(MC_DECEL_STOP_MODE)<br> Page 1523<br>MC_DECEL_STOP_MODE | LIST_READ_ONLY | The input status of stop selection at software stroke limit error occurrence is displayed.<br><ul style="list-style-type: none"> <li>• 1: Immediate stop (ImmediateStop)</li> <li>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)</li> <li>• 3: Alternative acceleration/deceleration (AlternativeAcc)</li> </ul>                                                                                                                                                                                                                                                                                                                                                           |
| StopOption_DriverTargetIgnored | Driver command discard detection setting                 | Ready ON        | BOOL                                                                                                                                             | LIST_READ_ONLY | The status of driver command discard detection setting is displayed.<br><ul style="list-style-type: none"> <li>• FALSE: Detection disabled</li> <li>• TRUE: Detection enabled</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| StopSignal                     | Stop signal                                              | Ready ON        | SIGNAL_SELECT<br> Page 1492<br>SIGNAL_SELECT<br>(Signal select) | LIST_READ_ONLY | The input status of the stop signal (STOP) of the external input signal is displayed.<br>Settings and operations specific to Stop signal (StopSignal) are shown below.<br><ul style="list-style-type: none"> <li>■ I/O number (StartIO)<br/>"0" is always displayed.</li> <li>■ Target (Target)<br/>The fetch result of the parameter is displayed.</li> <li>■ Signal detection method (Detection)<br/>The fetch result of the parameter is displayed.</li> <li>■ Compensation time (CompensationTime)<br/>"0.0" is always displayed.</li> <li>■ Filter time (FilterTime)<br/>The fetch result of the parameter is displayed.</li> </ul>                                                 |
| StopStatus                     | Stop status                                              | Operation cycle | BOOL                                                                                                                                             | LIST_READ_ONLY | The input status of the stop signal (STOP) of the external input signal is displayed.<br><ul style="list-style-type: none"> <li>• FALSE: Stop processing released</li> <li>• TRUE: During stop processing</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| SwStrokeLimit_Lower            | Software stroke limit lower value                        | Ready ON        | LREAL                                                                                                                                            | LIST_READ_ONLY | The software stroke limit lower value is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| SwStrokeLimit_Override         | Software stroke limit override                           | At start        | STRING(15)                                                                                                                                       | LIST_READ_ONLY | The software stroke limit valid/invalid status is displayed.<br><ul style="list-style-type: none"> <li>• DISABLE: Check disabled</li> <li>• ONLY_INSIDE: Check disabled for movement returning to the range</li> <li>• Others: Check enabled (no disable request)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                             |
| SwStrokeLimit_Target           | Software stroke limit target                             | Ready ON        | INT<br>(MC_POS_SOURCE)<br> Page 1524<br>MC_POS_SOURCE         | LIST_READ_ONLY | The software stroke limit target is displayed.<br><ul style="list-style-type: none"> <li>• -1: Invalid (Invalid)</li> <li>• 1: Set position (SetPosition)</li> <li>• 3: Feed machine position (FeedMachinePosition)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| SwStrokeLimit_Upper            | Software stroke limit upper value                        | Ready ON        | LREAL                                                                                                                                            | LIST_READ_ONLY | The software stroke limit upper value is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| TargetAcceleration             | Target acceleration                                      | Operation cycle | LREAL                                                                                                                                            | LIST_READ_ONLY | The maximum acceleration used during acceleration is stored. (Unit: U/s <sup>2</sup> )<br>During axes group operation, "0.0" is stored in Target acceleration ( <u>AxisName</u> .Md.TargetAcceleration) of the configuration axis.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| TargetDeceleration             | Target deceleration                                      | Operation cycle | LREAL                                                                                                                                            | LIST_READ_ONLY | The maximum deceleration used during deceleration is stored. (Unit: U/s <sup>2</sup> )<br>During axes group operation, "0.0" is stored in Target deceleration ( <u>AxisName</u> .Md.TargetDeceleration) of the configuration axis.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| TargetVelocity                 | Target velocity                                          | Operation cycle | LREAL                                                                                                                                            | LIST_READ_ONLY | The actual target velocity whose override and velocity limit value are considered is stored.<br>"0.0" is stored after the control is completed.<br>During axes group operation, "0.0" is stored in Target velocity ( <u>AxisName</u> .Md.TargetVelocity) of the configuration axis.<br><ul style="list-style-type: none"> <li>■ For positioning control<br/>The value becomes more than "0.0" regardless of the movement direction.</li> <li>■ For other than positioning control<br/>The value is positive when moving to the positive direction (Address increase direction), and the value is negative when moving to the negative direction (Address decrease direction).</li> </ul> |

| Variable name               | Name                                            | Import          | Data type                                                                                                                                                  | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------|-------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TorqueLimit_Negative        | Negative direction torque limit value           | Operation cycle | LREAL                                                                                                                                                      | LIST_READ_ONLY | The negative direction torque limit value that is currently valid is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| TorqueLimit_Positive        | Positive direction torque limit value           | Operation cycle | LREAL                                                                                                                                                      | LIST_READ_ONLY | The positive direction torque limit value that is currently valid is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Unit_Position               | Position command unit                           | Ready ON        | DWORD(HEX)                                                                                                                                                 | LIST_READ_ONLY | The position command unit to be used in the motion control is displayed.<br><ul style="list-style-type: none"> <li>• 00000000H: pulse</li> <li>• 00010000H: m</li> <li>• FD010000H: mm</li> <li>• FA010000H: <math>\mu</math>m</li> <li>• F7010000H: nm</li> <li>• 00410000H: degree</li> <li>• FD410000H: <math>\times 10^{-3}</math>degree</li> <li>• FA410000H: <math>\times 10^{-6}</math>degree</li> <li>• 00B40000H: Revolution</li> <li>• 00C00000H: inch</li> <li>• 00FF0000H: An arbitrary unit</li> </ul> |
| Unit_PositionDisplay        | Position command unit display                   | Ready ON        | WSTRING(31)                                                                                                                                                | LIST_READ_ONLY | The currently controlled position command unit is displayed as a string.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Unit_PositionString         | Position command unit string                    | Ready ON        | WSTRING(31)                                                                                                                                                | LIST_READ_ONLY | When Position command unit ( <u>AxisName</u> .Pr.Unit_Position) is set to "00FF0000H: arbitrary unit", the currently controlled position command unit set in Position command unit string ( <u>AxisName</u> .Pr.Unit_PositionString) is displayed as a string.                                                                                                                                                                                                                                                      |
| Unit_Velocity               | Velocity command unit                           | Ready ON        | DWORD(HEX)                                                                                                                                                 | LIST_READ_ONLY | The velocity command unit to be used in the motion control is displayed.<br><ul style="list-style-type: none"> <li>• 00000300H: U/s</li> <li>• 00004700H: U/min</li> <li>• FD000300H: U/ms</li> <li>• FA000300H: U/<math>\mu</math>s</li> <li>• F7000300H: U/ns</li> </ul>                                                                                                                                                                                                                                          |
| Unit_VelocityDisplay        | Velocity command unit display                   | Ready ON        | WSTRING(31)                                                                                                                                                | LIST_READ_ONLY | The currently controlled velocity command unit is output as a string.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| UseInGroup                  | Using axes group                                | Operation cycle | BOOL                                                                                                                                                       | LIST_READ_ONLY | Whether the specified axis is being used in the axes group or not is displayed.<br><ul style="list-style-type: none"> <li>• FALSE: Not used</li> <li>• TRUE: Used</li> </ul>                                                                                                                                                                                                                                                                                                                                        |
| VelocityBias                | Speed bias value                                | Ready ON        | LREAL                                                                                                                                                      | LIST_READ_ONLY | The setting value for Speed bias value ( <u>AxisName</u> .Pr.VelocityBias) that was imported during Ready ON is stored.                                                                                                                                                                                                                                                                                                                                                                                             |
| VelocityLimit_Negative      | Negative direction speed limit value            | Ready ON        | LREAL                                                                                                                                                      | LIST_READ_ONLY | The address decreasing direction speed limit value is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| VelocityLimit_OverOperation | Operation setting at speed limit value exceeded | Ready ON        | INT<br>(MC_VELOCITY_LIMIT_MODE)<br> Page 1522<br>MC_VELOCITY_LIMIT_MODE | LIST_READ_ONLY | The operation performed when the speed limit value is exceeded during control is displayed.<br><ul style="list-style-type: none"> <li>• 0: Ignore (Ignore)</li> <li>• 3: Immediate stop (ImmediateStop)</li> </ul>                                                                                                                                                                                                                                                                                                  |
| VelocityLimit_Positive      | Positive direction speed limit value            | Ready ON        | LREAL                                                                                                                                                      | LIST_READ_ONLY | The address increasing direction speed limit value is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| VelocityOverride            | Velocity override factor                        | Operation cycle | LREAL                                                                                                                                                      | LIST_READ_ONLY | The velocity override factor is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Warning                     | Axis warning detection                          | Immediately     | BOOL                                                                                                                                                       | LIST_READ_ONLY | The axis warning status is displayed.<br><ul style="list-style-type: none"> <li>• FALSE: No axis warning</li> <li>• TRUE: Axis warning present</li> </ul>                                                                                                                                                                                                                                                                                                                                                           |
| WarningID                   | Axis warning code                               | Immediately     | WORD(HEX)                                                                                                                                                  | LIST_READ_ONLY | The event code is stored when an axis warning occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

\*1 The stored value includes an error because a floating-point error occurs.

## AxisName.Cd. (Axis control data)

| Variable name          | Name                                  | Import          | Type       | Attribute      | Range                                                                                                                                                                                                                                 |
|------------------------|---------------------------------------|-----------------|------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AccelerationOverride   | Acceleration override factor          | Operation cycle | LREAL      | LIST_READ_ONLY | The acceleration override factor is set.<br>• 0.01 to 10.00                                                                                                                                                                           |
| Encoder_Connect        | Connection command                    | Operation cycle | BOOL       | LIST_READ_ONLY | The connection status of the virtual encoder axis input is switched between valid and invalid.<br>• FALSE: Disabled<br>• TRUE: Enabled                                                                                                |
| Encoder_CounterDisable | Counter disabled                      | Operation cycle | BOOL       | LIST_READ_ONLY | The signal to switch to the counter disable is set.<br>• FALSE: Not executed<br>• TRUE: Execute the counter disable request                                                                                                           |
| Encoder_InputValue     | Encoder input value                   | Operation cycle | DINT       | LIST_READ_ONLY | The values used as the virtual encoder axis input values are sequentially set.                                                                                                                                                        |
| ErrorReset             | Axis error reset                      | Service         | BOOL       | LIST_READ_ONLY | Axis errors/warnings and drive unit errors are reset. This variable becomes FALSE when the error reset is completed.<br>• FALSE: Not executed<br>• TRUE: Executes the error reset                                                     |
| FollowupDisable        | Follow-up disabled                    | Operation cycle | BOOL       | LIST_READ_ONLY | The follow-up is disabled.<br>• FALSE: Not executed<br>• TRUE: Executes the followup disable request                                                                                                                                  |
| Homing_ClearRequest    | Home position return request clear    | Operation cycle | BOOL       | LIST_READ_ONLY | The homing request is cleared.<br>Homing Request Clear (Homing_ClearRequest) becomes FALSE automatically after Homing Request (Homing_Request) is set to FALSE.<br>• FALSE: Not executed<br>• TRUE: Executes the homing request clear |
| HwStrokeLimit_Override | Hardware stroke limit override        | At start        | STRING(15) | LIST_READ_ONLY | The hardware stroke limit valid/invalid status is temporarily switched.<br>• DISABLE: Check disabled<br>• ONLY_INSIDE: Check disabled for movement returning to the range<br>• Others: No disable request                             |
| SwStrokeLimit_Override | Software stroke limit override        | At start        | STRING(15) | LIST_READ_ONLY | The software stroke limit valid/invalid status is temporarily switched.<br>• DISABLE: Check disabled<br>• ONLY_INSIDE: Check disabled for movement returning to the range<br>• Others: Check enabled (no disable request)             |
| TorqueLimit_Negative   | Negative direction torque limit value | Operation cycle | LREAL      | LIST_READ_ONLY | The negative direction torque limit value is set.<br>• 0.0 to 1000.0 [%]                                                                                                                                                              |
| TorqueLimit_Positive   | Positive direction torque limit value | Operation cycle | LREAL      | LIST_READ_ONLY | The positive direction torque limit value is set.<br>• 0.0 to 1000.0 [%]                                                                                                                                                              |
| VelocityOverride       | Velocity override factor              | Operation cycle | LREAL      | LIST_READ_ONLY | The velocity override factor is set.<br>• 0.00 to 10.00                                                                                                                                                                               |



## Variables settable as the axis variable for each axis type

The variables that can be set and used as the axis variable differ for each axis type.

The variables that can be set for each axis type are shown below.

### ■AxisName.AxisRef. (Axis information)

○: Can be set, ×: Cannot be set

| Variable name | Name     | Axis type       |                   |                    |                      |                   |
|---------------|----------|-----------------|-------------------|--------------------|----------------------|-------------------|
|               |          | Real drive axis | Real encoder axis | Virtual drive axis | Virtual encoder axis | Virtual link axis |
| AxisNo        | Axis No. | ○               | ○                 | ○                  | ○                    | ○                 |
| StartIO       | I/O No.  | ○               | ○                 | ○                  | ○                    | ○                 |

### ■AxisName.PrConst. (Axis parameter constant)

○: Can be set, ×: Cannot be set

| Variable name                | Name                                          | Axis type       |                   |                    |                      |                   |
|------------------------------|-----------------------------------------------|-----------------|-------------------|--------------------|----------------------|-------------------|
|                              |                                               | Real drive axis | Real encoder axis | Virtual drive axis | Virtual encoder axis | Virtual link axis |
| AddressOfStation             | Station address setting                       | ○               | ○                 | ×                  | ×                    | ×                 |
| AxisType                     | Axis type setting                             | ○               | ○                 | ○                  | ○                    | ○                 |
| Encoder_AxisType             | Real encoder axis type setting                | ×               | ○                 | ×                  | ×                    | ×                 |
| Encoder_CounterDisableSignal | Counter disabling signal                      | ×               | ○                 | ×                  | ○                    | ×                 |
| Encoder_RingCout_LowerValue  | Encoder ring counter lower limit value        | ×               | ×                 | ×                  | ○                    | ×                 |
| Encoder_RingCout_UpperValue  | Encoder ring counter upper limit value        | ×               | ×                 | ×                  | ○                    | ×                 |
| HwStrokeLimit_FlsSignal      | Upper limit signal                            | ○               | ×                 | ○                  | ×                    | ×                 |
| HwStrokeLimit_RlsSignal      | Lower limit signal                            | ○               | ×                 | ○                  | ×                    | ×                 |
| OperationCycle               | Control cycle setting                         | ○               | ○                 | ○                  | ○                    | ○                 |
| PosRestoration_AbsPosEnable  | Absolute position control setting             | ○               | ○                 | ○                  | ○                    | ○                 |
| RingCount_Enable             | Ring counter enabled selection                | ○               | ○                 | ○                  | ○                    | ○                 |
| RingCount_LowerValue         | Ring counter lower limit value                | ○               | ○                 | ○                  | ○                    | ○                 |
| RingCount_UpperValue         | Ring counter upper limit value                | ○               | ○                 | ○                  | ○                    | ○                 |
| SlaveEmulate_Enable          | Axis emulation enabled                        | ○               | ×                 | ×                  | ×                    | ×                 |
| SlaveObject                  | Object data                                   | ×               | ×                 | ×                  | ○                    | ×                 |
| TorqueLimit_Max              | Torque limit maximum value                    | ○               | ×                 | ×                  | ×                    | ×                 |
| TorqueLimit_NegativeInitial  | Negative direction torque limit initial value | ○               | ×                 | ×                  | ×                    | ×                 |
| TorqueLimit_PositiveInitial  | Positive direction torque limit initial value | ○               | ×                 | ×                  | ×                    | ×                 |

## ■AxisName.Pr. (Axis parameter)

○: Can be set, ×: Cannot be set

| Variable name                  | Name                                                     | Axis type       |                   |                    |                      |                   |
|--------------------------------|----------------------------------------------------------|-----------------|-------------------|--------------------|----------------------|-------------------|
|                                |                                                          | Real drive axis | Real encoder axis | Virtual drive axis | Virtual encoder axis | Virtual link axis |
| AccelerationLimit              | Acceleration limit value                                 | ○               | ×                 | ○                  | ×                    | ×                 |
| AccelerationZeroBehavior       | Operation selection at start acceleration/deceleration 0 | ○               | ×                 | ○                  | ×                    | ×                 |
| CmdInPos_Width                 | Command in-position width                                | ○               | ×                 | ○                  | ×                    | ×                 |
| DecelerationLimit              | Deceleration limit value                                 | ○               | ×                 | ○                  | ×                    | ×                 |
| Drive_UnitConvRatioNum         | Driver unit conversion numerator                         | ○               | ○                 | ×                  | ○                    | ×                 |
| Drive_UnitConvRatioDen         | Driver unit conversion denominator                       | ○               | ○                 | ×                  | ○                    | ×                 |
| ForcedStop_Signal              | Forced stop signal                                       | ○               | ×                 | ○                  | ×                    | ×                 |
| Homing_Required                | Home position return required or not                     | ○               | ○                 | ○                  | ○                    | ○                 |
| JerkLimit                      | Jerk limit value                                         | ○               | ×                 | ○                  | ×                    | ×                 |
| OverrunOperation               | Operation setting at overrun                             | ○               | ×                 | ○                  | ×                    | ×                 |
| StartableAtUnhomed             | Start permission at home position return uncompleted     | ○               | ○                 | ○                  | ○                    | ○                 |
| StopMode_Deceleration          | Deceleration at stop                                     | ○               | ×                 | ○                  | ×                    | ×                 |
| StopMode_DecelerationCurve     | Stop selection at deceleration to stop                   | ○               | ×                 | ○                  | ×                    | ×                 |
| StopMode_General               | Stop selection at stop by factors                        | ○               | ×                 | ○                  | ×                    | ×                 |
| StopMode_HwStrokeLimit         | Stop selection at hardware stroke limit error occurrence | ○               | ×                 | ○                  | ×                    | ×                 |
| StopMode_ServoOff              | Process selection at servo OFF command during operation  | ○               | ×                 | ○                  | ×                    | ×                 |
| StopMode_SwStrokeLimit         | Stop selection at software stroke limit error occurrence | ○               | ×                 | ○                  | ×                    | ×                 |
| StopOption_DriverTargetIgnored | Driver command discard detection setting                 | ○               | ×                 | ×                  | ×                    | ×                 |
| StopSignal                     | Stop signal                                              | ○               | ×                 | ○                  | ×                    | ×                 |
| SwStrokeLimit_Lower            | Software stroke limit lower value                        | ○               | ×                 | ○                  | ×                    | ×                 |
| SwStrokeLimit_Target           | Software stroke limit target                             | ○               | ×                 | ○                  | ×                    | ×                 |
| SwStrokeLimit_Upper            | Software stroke limit upper value                        | ○               | ×                 | ○                  | ×                    | ×                 |
| Unit_Position                  | Position command unit                                    | ○               | ○                 | ○                  | ○                    | ○                 |
| Unit_PositionString            | Position command unit string                             | ○               | ○                 | ○                  | ○                    | ○                 |
| Unit_Velocity                  | Velocity command unit                                    | ○               | ○                 | ○                  | ○                    | ○                 |
| VelocityBias                   | Speed bias value                                         | ○               | ×                 | ○                  | ×                    | ○                 |
| VelocityLimit_Negative         | Negative direction speed limit value                     | ○               | ×                 | ○                  | ×                    | ×                 |
| VelocityLimit_OverOperation    | Operation setting at speed limit value exceeded          | ○               | ×                 | ○                  | ×                    | ×                 |
| VelocityLimit_Positive         | Positive direction speed limit value                     | ○               | ×                 | ○                  | ×                    | ×                 |

## ■AxisName.Md. (Axis monitor data)

○: Can be set, ×: Cannot be set

| Variable name            | Name                                                     | Axis type       |                   |                    |                      |                   |
|--------------------------|----------------------------------------------------------|-----------------|-------------------|--------------------|----------------------|-------------------|
|                          |                                                          | Real drive axis | Real encoder axis | Virtual drive axis | Virtual encoder axis | Virtual link axis |
| AccelerationLimit        | Acceleration limit value                                 | ○               | ×                 | ○                  | ×                    | ×                 |
| AccelerationOverride     | Acceleration override factor                             | ○               | ×                 | ○                  | ×                    | ×                 |
| AccelerationZeroBehavior | Operation selection at start acceleration/deceleration 0 | ○               | ×                 | ○                  | ×                    | ×                 |
| ActualPosition           | Actual position                                          | ○               | ○                 | ×                  | ×                    | ×                 |
| ActualVelocity           | Actual velocity                                          | ○               | ○                 | ×                  | ×                    | ×                 |
| Analyzing                | Analyzing                                                | ○               | ○                 | ○                  | ○                    | ○                 |
| AutoDeceleration         | Automatically decelerating                               | ○               | ×                 | ○                  | ×                    | ×                 |
| AxisName                 | Axis name                                                | ○               | ○                 | ○                  | ○                    | ○                 |
| AxisStatus               | Axis status                                              | ○               | ○                 | ○                  | ○                    | ○                 |
| BufferingFBs             | Number of buffering FBs                                  | ○               | ×                 | ○                  | ×                    | ×                 |
| CmdInPos                 | Command in-position                                      | ○               | ×                 | ○                  | ×                    | ×                 |
| CmdInPos_Width           | Command in-position width                                | ○               | ×                 | ○                  | ×                    | ×                 |
| CommandedAcceleration    | Specified acceleration                                   | ○               | ×                 | ○                  | ×                    | ×                 |
| CommandedDeceleration    | Specified deceleration                                   | ○               | ×                 | ○                  | ×                    | ×                 |
| CommandedJerk            | Specified jerk                                           | ○               | ×                 | ○                  | ×                    | ×                 |
| CommandedPosition        | Commanded position                                       | ○               | ×                 | ○                  | ×                    | ×                 |
| CommandedVelocity        | Commanded velocity                                       | ○               | ×                 | ○                  | ×                    | ×                 |
| Cst_SetTorque            | Set torque at cst/ct                                     | ○               | ×                 | ×                  | ×                    | ×                 |
| Cst_TargetTorque         | Target torque at cst/ct                                  | ○               | ×                 | ×                  | ×                    | ×                 |
| CumulativePosition       | Cumulative current position                              | ○               | ○                 | ○                  | ○                    | ○                 |
| DecelerationLimit        | Deceleration limit value                                 | ○               | ×                 | ○                  | ×                    | ×                 |
| Drive_RPDO[1..64]        | RPDO (Motion system → Device station) mapping            | ○               | ×                 | ×                  | ×                    | ×                 |
| Drive_TPDO[1..64]        | TPDO (Device → Motion system) mapping                    | ○               | ×                 | ×                  | ×                    | ×                 |
| Drive_UnitConvRatioNum   | Driver unit conversion numerator                         | ○               | ○                 | ×                  | ×                    | ×                 |
| Drive_UnitConvRatioDen   | Driver unit conversion denominator                       | ○               | ○                 | ×                  | ×                    | ×                 |
| Driver_Mode              | Driver control mode                                      | ○               | ×                 | ×                  | ×                    | ×                 |
| Driver_ReadyOn           | Driver ready ON status                                   | ○               | ×                 | ×                  | ×                    | ×                 |
| Driver_ServoOn           | Driver servo ON status                                   | ○               | ×                 | ×                  | ×                    | ×                 |
| Driver_State             | Driver status                                            | ○               | ×                 | ×                  | ×                    | ×                 |
| DriverError              | Drive unit error detection                               | ○               | ×                 | ×                  | ×                    | ×                 |
| DriverErrorID            | Drive unit error code                                    | ○               | ×                 | ×                  | ×                    | ×                 |
| DriverErrorDetailID      | Drive unit error detail code                             | ○               | ×                 | ×                  | ×                    | ×                 |
| Encoder_Connected        | Connection status                                        | ×               | ×                 | ×                  | ○                    | ×                 |
| Encoder_CounterDisable   | Counter disabled                                         | ×               | ○                 | ×                  | ○                    | ×                 |
| Error                    | Axis error detection                                     | ○               | ○                 | ○                  | ○                    | ○                 |
| ErrorID                  | Axis error code                                          | ○               | ○                 | ○                  | ○                    | ○                 |
| FeedMachinePosition      | Feed machine position                                    | ○               | ×                 | ×                  | ×                    | ×                 |
| FollowupDisable          | Follow-up disabled                                       | ○               | ×                 | ×                  | ×                    | ×                 |
| ForcedStop_Released      | Forced stop cancelling                                   | ○               | ×                 | ○                  | ×                    | ×                 |
| ForcedStop_Signal        | Forced stop signal                                       | ○               | ×                 | ○                  | ×                    | ×                 |
| Homing_Complete          | Home position return completed                           | ○               | ○                 | ○                  | ○                    | ○                 |
| Homing_Request           | Home position return request                             | ○               | ○                 | ○                  | ○                    | ○                 |
| Homing_Required          | Home position return required or not                     | ○               | ○                 | ○                  | ○                    | ○                 |

| Variable name                  | Name                                                     | Axis type       |                   |                    |                      |                   |
|--------------------------------|----------------------------------------------------------|-----------------|-------------------|--------------------|----------------------|-------------------|
|                                |                                                          | Real drive axis | Real encoder axis | Virtual drive axis | Virtual encoder axis | Virtual link axis |
| Homing_Status                  | Home position return operation status                    | ○               | ×                 | ×                  | ×                    | ×                 |
| HwStrokeLimit_FlsStatus        | Upper limit signal status                                | ○               | ×                 | ○                  | ×                    | ×                 |
| HwStrokeLimit_Override         | Hardware stroke limit override                           | ○               | ×                 | ○                  | ×                    | ×                 |
| HwStrokeLimit_RlsStatus        | Lower limit signal status                                | ○               | ×                 | ○                  | ×                    | ×                 |
| InVelocity                     | Target velocity reached                                  | ○               | ×                 | ○                  | ×                    | ×                 |
| Io_PosActualValue              | Object data_PosActualValue                               | ○               | ○                 | ×                  | ○                    | ×                 |
| Io_PosEncoderResolution        | Object data_PosEncoderResolution                         | ×               | ○                 | ×                  | ○                    | ×                 |
| Io_Statusword                  | Object data_Statusword                                   | ○               | ○                 | ×                  | ×                    | ×                 |
| Io_TargetPos                   | Object data_TargetPos                                    | ○               | ×                 | ○                  | ×                    | ×                 |
| Io_TargetVelocity              | Object data_TargetVelocity                               | ○               | ×                 | ×                  | ×                    | ×                 |
| Io_TorqueActualValue           | Object data_TorqueActualValue                            | ○               | ×                 | ×                  | ×                    | ×                 |
| Io_VelActualValue              | Object data_VelActualValue                               | ○               | ×                 | ×                  | ×                    | ×                 |
| JerkLimit                      | Jerk limit value                                         | ○               | ×                 | ○                  | ×                    | ×                 |
| OperationCycle                 | Control cycle                                            | ○               | ○                 | ○                  | ○                    | ○                 |
| OverrunOperation               | Operation setting at overrun                             | ○               | ×                 | ○                  | ×                    | ×                 |
| PosRestoration_Status          | Current position restoration status                      | ○               | ○                 | ○                  | ○                    | ○                 |
| ProfileID                      | Execution profile ID No.                                 | ○               | ×                 | ○                  | ×                    | ○                 |
| SetAcceleration                | Set current acceleration                                 | ○               | ×                 | ○                  | ×                    | ×                 |
| SetPosition                    | Set position                                             | ○               | ○                 | ○                  | ○                    | ○                 |
| SetVelocity                    | Set velocity                                             | ○               | ×                 | ○                  | ○                    | ×                 |
| SlaveEmulate_Enable            | Axis emulating                                           | ○               | ×                 | ×                  | ×                    | ×                 |
| StartableAtUnhomed             | Start permission at home position return uncompleted     | ○               | ○                 | ○                  | ○                    | ○                 |
| StopMode_Deceleration          | Deceleration at stop                                     | ○               | ×                 | ○                  | ×                    | ×                 |
| StopMode_DecelerationCurve     | Stop selection at deceleration to stop                   | ○               | ×                 | ○                  | ×                    | ×                 |
| StopMode_General               | Stop selection at stop by factors                        | ○               | ×                 | ○                  | ×                    | ×                 |
| StopMode_HwStrokeLimit         | Stop selection at hardware stroke limit error occurrence | ○               | ×                 | ○                  | ×                    | ×                 |
| StopMode_ServoOff              | Process selection at servo OFF command during operation  | ○               | ×                 | ○                  | ×                    | ×                 |
| StopMode_SwStrokeLimit         | Stop selection at software stroke limit error occurrence | ○               | ×                 | ○                  | ×                    | ×                 |
| StopOption_DriverTargetIgnored | Driver command discard detection setting                 | ○               | ×                 | ×                  | ×                    | ×                 |
| StopSignal                     | Stop signal                                              | ○               | ×                 | ○                  | ×                    | ×                 |
| StopStatus                     | Stop status                                              | ○               | ×                 | ○                  | ×                    | ×                 |
| SwStrokeLimit_Lower            | Software stroke limit lower value                        | ○               | ×                 | ○                  | ×                    | ×                 |
| SwStrokeLimit_Override         | Software stroke limit override                           | ○               | ×                 | ○                  | ×                    | ×                 |
| SwStrokeLimit_Target           | Software stroke limit target                             | ○               | ×                 | ○                  | ×                    | ×                 |
| SwStrokeLimit_Upper            | Software stroke limit upper value                        | ○               | ×                 | ○                  | ×                    | ×                 |
| TargetAcceleration             | Target acceleration                                      | ○               | ×                 | ○                  | ×                    | ×                 |
| TargetDeceleration             | Target deceleration                                      | ○               | ×                 | ○                  | ×                    | ×                 |
| TargetVelocity                 | Target velocity                                          | ○               | ×                 | ○                  | ×                    | ×                 |
| TorqueLimit_Negative           | Negative direction torque limit value                    | ○               | ×                 | ×                  | ×                    | ×                 |

| Variable name               | Name                                            | Axis type       |                   |                    |                      |                   |
|-----------------------------|-------------------------------------------------|-----------------|-------------------|--------------------|----------------------|-------------------|
|                             |                                                 | Real drive axis | Real encoder axis | Virtual drive axis | Virtual encoder axis | Virtual link axis |
| TorqueLimit_Positive        | Positive direction torque limit value           | ○               | ×                 | ×                  | ×                    | ×                 |
| Unit_Position               | Position command unit                           | ○               | ○                 | ○                  | ○                    | ○                 |
| Unit_PositionDisplay        | Position command unit display                   | ○               | ○                 | ○                  | ○                    | ○                 |
| Unit_PositionString         | Position command unit string                    | ○               | ○                 | ○                  | ○                    | ○                 |
| Unit_Velocity               | Velocity command unit                           | ○               | ○                 | ○                  | ○                    | ○                 |
| Unit_VelocityDisplay        | Velocity command unit display                   | ○               | ○                 | ○                  | ○                    | ○                 |
| UseInGroup                  | Using axes group                                | ○               | ○                 | ○                  | ○                    | ○                 |
| VelocityBias                | Speed bias value                                | ○               | ×                 | ○                  | ×                    | ○                 |
| VelocityLimit_Negative      | Negative direction speed limit value            | ○               | ×                 | ○                  | ×                    | ×                 |
| VelocityLimit_OverOperation | Operation setting at speed limit value exceeded | ○               | ×                 | ○                  | ×                    | ×                 |
| VelocityLimit_Positive      | Positive direction speed limit value            | ○               | ×                 | ○                  | ×                    | ×                 |
| VelocityOverride            | Velocity override factor                        | ○               | ×                 | ○                  | ×                    | ×                 |
| Warning                     | Axis warning detection                          | ○               | ○                 | ○                  | ○                    | ○                 |
| WarningID                   | Axis warning code                               | ○               | ○                 | ○                  | ○                    | ○                 |

#### ■AxisName.Cd. (Axis control data)

○: Can be set, ×: Cannot be set

| Variable name          | Name                                  | Axis type       |                   |                    |                      |                   |
|------------------------|---------------------------------------|-----------------|-------------------|--------------------|----------------------|-------------------|
|                        |                                       | Real drive axis | Real encoder axis | Virtual drive axis | Virtual encoder axis | Virtual link axis |
| AccelerationOverride   | Acceleration override factor          | ○               | ×                 | ○                  | ×                    | ×                 |
| Encoder_Connect        | Connection command                    | ×               | ×                 | ×                  | ○                    | ×                 |
| Encoder_CounterDisable | Counter disabled                      | ×               | ○                 | ×                  | ○                    | ×                 |
| Encoder_InputValue     | Encoder input value                   | ×               | ×                 | ×                  | ○                    | ×                 |
| ErrorReset             | Axis error reset                      | ○               | ○                 | ○                  | ○                    | ○                 |
| FollowupDisable        | Follow-up disabled                    | ○               | ×                 | ×                  | ×                    | ×                 |
| Homing_ClearRequest    | Home position return request clear    | ○               | ○                 | ○                  | ○                    | ○                 |
| HwStrokeLimit_Override | Hardware stroke limit override        | ○               | ×                 | ○                  | ×                    | ×                 |
| SwStrokeLimit_Override | Software stroke limit override        | ○               | ×                 | ○                  | ×                    | ×                 |
| TorqueLimit_Negative   | Negative direction torque limit value | ○               | ×                 | ×                  | ×                    | ×                 |
| TorqueLimit_Positive   | Positive direction torque limit value | ○               | ×                 | ×                  | ×                    | ×                 |
| VelocityOverride       | Velocity override factor              | ○               | ×                 | ○                  | ×                    | ×                 |

# Axes group variables

The data type of axes group variables is expressed as AXES\_GROUP.

Each axes group data type has the following members.

| Member name  | Data type            | Description                                                                                                                                                                                                                                                  | Reference                                                                            |
|--------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| AxesGroupRef | AXES_GROUP_REF       | The data structure for input/output of the Motion control FBs.                                                                                                                                                                                               | Page 1468<br><a href="#">AxesGroupName.AxesGroupRef</a> . (Axes group information)   |
| PrConst      | AXES_GROUP_PRM_CONST | Stores parameter data (constant) of the axes group.<br>Opens the setting value at the axis group variable initialization.<br>Re-importing to the control data is not executed after axes group variables initialization.                                     | Page 1468<br><a href="#">AxesGroupName.PrConst</a> . (Axes group parameter constant) |
| Pr           | AXES_GROUP_PRM       | Stores the parameter data for the axes group.<br>Opens the default value at axes group variable generation.<br>Reload to the control is executed after the axes group initialization.<br>The fetch timing to the control changes depending on the parameter. | Page 1468<br><a href="#">AxesGroupName.Pr</a> . (Axes group parameter)               |
| Md           | AXES_GROUP_MONI      | Stores the monitor data for the axes group.<br>Executes refresh in the fixed cycle for each monitor data.                                                                                                                                                    | Page 1470<br><a href="#">AxesGroupName.Md</a> . (Axes group monitor data)            |
| Cd           | AXES_GROUP_CMD       | Stores the command data for axes group control.<br>Acquires the latest value every control operation cycle and uses it for the control.                                                                                                                      | Page 1474<br><a href="#">AxesGroupName.Cd</a> . (Axes group control data)            |

## AxesGroupName.AxesGroupRef. (Axes group information)

| Variable name | Name           | Import | Data type  | Attribute       | Description                                                                    |
|---------------|----------------|--------|------------|-----------------|--------------------------------------------------------------------------------|
| GroupNo       | Axes group No. | —      | WORD(UINT) | LIST_WRITE_BACK | The axes group No. is set.<br>• 0: Not set<br>• 1 to 10000: Set axes group No. |
| StartIO       | I/O No.        | —      | WORD(HEX)  | LIST_WRITE_BACK | The I/O No. is set.                                                            |

## AxesGroupName.PrConst. (Axes group parameter constant)

| Variable name | Name                    | Import          | Data type                                                                                                                                          | Attribute       | Description                                           |
|---------------|-------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------------------------------------------|
| AxesGroupType | Axes group type setting | At system start | INT<br>(MC_AXES_GROUP_TYPE)<br> Page 1524<br>MC_AXES_GROUP_TYPE | LIST_WRITE_BACK | Sets the axes group type.<br>• 0: Standard (Standard) |

## AxesGroupName.Pr. (Axes group parameter)

| Variable name            | Name                                                     | Import   | Data type                                                                                                                                      | Attribute       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|----------------------------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AccelerationLimit        | Acceleration limit value                                 | Ready ON | LREAL                                                                                                                                          | LIST_WRITE_BACK | The acceleration limit value is set.<br>• 0.0000, 0.0001 to 2147483647.0<br>* When the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)", it limits the acceleration calculated from the specified acceleration/deceleration time.<br>* When "0.0000" is set, it does not limit the acceleration.<br>* When a positive number less than 0.0001 is set, the value is imported as "0.0000". |
| AccelerationZeroBehavior | Operation selection at start acceleration/deceleration 0 | Ready ON | INT<br>(MC_ACC_ZERO_MODE)<br> Page 1524<br>MC_ACC_ZERO_MODE | LIST_WRITE_BACK | The behavior when "0.0" is set as the acceleration, the deceleration, or the acceleration/deceleration time at start is set.<br>• -1: Error (Not started) (ACCErrror)<br>• 1: Maximum acceleration/deceleration (MaximumAcceleration)                                                                                                                                                                                                             |

| Variable name              | Name                                                           | Import   | Data type                                                          | Attribute            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------|----------------------------------------------------------------|----------|--------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis[1..16]                | Configuration axis                                             | Ready ON | AXIS_REF<br>☞ Page 1444<br>AxisName.AxisRef.<br>(Axis information) | LIST_WRITE<br>E_BACK | The Axis No. (AxisNo) of Axis information ( <u>AxisName.AxisRef</u> ) that configures the axes group is set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| CmdInPos_Width             | Command in-position width                                      | Ready ON | LREAL                                                              | LIST_WRITE<br>E_BACK | The command in-position width on the composite axis of the axes group is set.<br>• 0.0: Function disabled<br>• 0.000000001 to 10000000000.0: Function enabled<br>* When a positive number less than 0.000000001 is set, the value is imported as "0.0".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| DecelerationLimit          | Deceleration limit value                                       | Ready ON | LREAL                                                              | LIST_WRITE<br>E_BACK | The deceleration limit value is set.<br>• 0.0000, 0.0001 to 2147483647.0<br>* When the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)", it limits the deceleration calculated from the specified acceleration/deceleration time.<br>* When "0.0000" is set, it does not limit the deceleration.<br>* When a positive number less than 0.0001 is set, the value is imported as "0.0000".                                                                                                                                                                                                                                                                                                                                                              |
| JerkLimit                  | Jerk limit value                                               | Ready ON | LREAL                                                              | LIST_WRITE<br>E_BACK | The jerk limit value is set.<br>• 0.0000, 0.0001 to 2147483647.0<br>* When "0.0000" is set, it does not limit the jerk.<br>* When a positive number less than 0.0001 is set, the value is imported as "0.0000".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| OverrunOperation           | Operation setting at overrun                                   | Ready ON | INT<br>(MC_DECEL_STOP_MODE)<br>☞ Page 1523<br>MC_DECEL_STOP_MODE   | LIST_WRITE<br>E_BACK | The operation performed when the target position is exceeded during operation is set.<br>• 1: Immediate stop (ImmediateStop)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| StopMode_Deceleration      | Deceleration at stop                                           | Ready ON | LREAL                                                              | LIST_WRITE<br>E_BACK | The deceleration/deceleration time at deceleration stop by stop cause occurrence is set.<br>■ When using acceleration/deceleration method specifying acceleration/deceleration (acceleration/deceleration specification method)<br>• 0.0000, 0.0001 to 2147483647.0<br>■ When using acceleration/deceleration method specifying acceleration/deceleration time (acceleration/deceleration time-fixed method)<br>• 0.000000, 0.000001 to 8400.0<br>* If this variable is set to "0.0", immediately stops regardless of the setting of Operation selection at start acceleration/deceleration 0 (AccelerationZeroBehavior)<br>* Clamp by the upper limit value when the upper limit value is out of the range at stop by factors, and handle as "0 (Immediate stop)" when lower limit value is out of the range. |
| StopMode_DecelerationCurve | Stop selection at deceleration to stop                         | Ready ON | INT<br>(MC_STOP_CURVE_MODE)<br>☞ Page 1523<br>MC_STOP_CURVE_MODE   | LIST_WRITE<br>E_BACK | The operation performed when a stop cause occurs during deceleration (including a stop cause and automatic deceleration) is set.<br>• 1: Recreate deceleration curve (OverrideCurve)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| StopMode_ErrorInGroup      | Configuration axis operation selection at axis stop by factors | Ready ON | INT<br>(MC_DECEL_STOP_MODE)<br>☞ Page 1523<br>MC_DECEL_STOP_MODE   | LIST_WRITE<br>E_BACK | During axes group operation, when the drive unit becomes servo OFF on the configuration axis and an immediate stop axis error occurs, the operation of the axis on which an error has not occurred is set.<br>• 1: Immediate stop (ImmediateStop)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| Variable name       | Name                              | Import                   | Data type                                                                                                                                        | Attribute       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------|-----------------------------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| StopMode_General    | Stop selection at stop by factors | Ready ON                 | INT<br>(MC_DECEL_STOP_MODE)<br> Page 1523<br>MC_DECEL_STOP_MODE | LIST_WRITE_BACK | The operation performed when a stop cause occurs is set.<br><ul style="list-style-type: none"> <li>• 1: Immediate stop (ImmediateStop)</li> <li>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)</li> <li>• 3: Alternative acceleration/deceleration (AlternativeAcc)</li> </ul> * Immediate stop will be executed when executing an FB without deceleration specification.                                                                                                          |
| Unit_Position       | Position command unit             | When axes group is valid | DWORD(HEX)                                                                                                                                       | LIST_WRITE_BACK | The position command unit to be used in the motion control is set.<br><ul style="list-style-type: none"> <li>• 00000000H: pulse</li> <li>• 00010000H: m</li> <li>• FD010000H: mm</li> <li>• FA010000H: μm</li> <li>• F7010000H: nm</li> <li>• 00410000H: degree</li> <li>• FD410000H: <math>\times 10^{-3}</math> degree</li> <li>• FA410000H: <math>\times 10^{-6}</math> degree</li> <li>• 00B40000H: Revolution</li> <li>• 00C00000H: inch</li> <li>• 00FF0000H: An arbitrary unit</li> </ul> |
| Unit_PositionString | Position command unit string      | When axes group is valid | WSTRING(31)                                                                                                                                      | LIST_WRITE_BACK | The command unit to be used in the motion control is set as a string.<br>This variable is set when Position command unit (Unit_Position) is set to "00FF0000H: arbitrary unit".                                                                                                                                                                                                                                                                                                                  |
| Unit_Velocity       | Velocity command unit             | When axes group is valid | DWORD(HEX)                                                                                                                                       | LIST_WRITE_BACK | The velocity command unit to be used in the motion control is set.<br><ul style="list-style-type: none"> <li>• 00000300H: U/s</li> <li>• 00004700H: U/min</li> <li>• FD000300H: U/ms</li> <li>• FA000300H: U/μs</li> <li>• F7000300H: U/ns</li> </ul>                                                                                                                                                                                                                                            |
| VelocityBias        | Speed bias value                  | Ready ON                 | LREAL                                                                                                                                            | LIST_WRITE_BACK | The speed bias value is set for each axes group. When "0.0000" is set, the speed bias is invalid.<br><ul style="list-style-type: none"> <li>• 0.0000, 0.0001 to 2500000000.0</li> </ul>                                                                                                                                                                                                                                                                                                          |
| VelocityLimit       | Velocity limit value              | Ready ON                 | LREAL                                                                                                                                            | LIST_WRITE_BACK | The velocity limit value of the axes group is set.<br><ul style="list-style-type: none"> <li>• 0.0001 to 2500000000.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                 |

### AxesGroupName.Md. (Axes group monitor data)

| Variable name            | Name                                                     | Import                        | Data type                                                                                                                                      | Attribute      | Description                                                                                                                                                                                                                                                                                        |
|--------------------------|----------------------------------------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AccelerationLimit        | Acceleration limit value                                 | Ready ON                      | LREAL                                                                                                                                          | LIST_READ_ONLY | The acceleration limit value is stored.                                                                                                                                                                                                                                                            |
| AccelerationOverride     | Acceleration override factor                             | Operation cycle               | LREAL                                                                                                                                          | LIST_READ_ONLY | The acceleration override factor is stored.                                                                                                                                                                                                                                                        |
| AccelerationZeroBehavior | Operation selection at start acceleration/deceleration 0 | Ready ON                      | INT<br>(MC_ACC_ZERO_MODE)<br> Page 1524<br>MC_ACC_ZERO_MODE | LIST_READ_ONLY | The behavior when "0.0" is set as the acceleration, the deceleration, or the acceleration/deceleration time at start is displayed.<br><ul style="list-style-type: none"> <li>• -1: Error (Not started) (ACCError)</li> <li>• 1: Maximum acceleration/deceleration (MaximumAcceleration)</li> </ul> |
| ActualVelocity           | Actual velocity                                          | Operation cycle (GroupEnable) | LREAL                                                                                                                                          | LIST_READ_ONLY | The actual velocity is stored.<br>This velocity is the vector speed of the actual velocity of the configuration axes. The value becomes more than "0.0" regardless of the movement direction of the configuration axis.<br>"0.0" is stored when the axes group is invalid.                         |
| Analyzing                | Analyzing                                                | Operation cycle               | BOOL                                                                                                                                           | LIST_READ_ONLY | The status of positioning analyzing of the axes group is displayed.<br><ul style="list-style-type: none"> <li>• FALSE: Not analyzing</li> <li>• TRUE: Analyzing</li> </ul>                                                                                                                         |



| Variable name         | Name                       | Import                        | Data type                                                                                                                                          | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------|----------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AutoDeceleration      | Automatically decelerating | Operation cycle (GroupEnable) | BOOL                                                                                                                                               | LIST_READ_ONLY | The auto deceleration processing status is displayed. TRUE is stored while the auto deceleration processing is being performed. When the multiple start is executed, this variable becomes TRUE while the auto deceleration processing is being performed during the last positioning point execution. This variable becomes FALSE when the control change is performed. <ul style="list-style-type: none"> <li>FALSE: Not during auto deceleration</li> <li>TRUE: Automatically decelerating</li> </ul> |
| Axis[1..16]           | Configuration axis         | Immediately                   | AXIS_REF<br> Page 1444<br>AxisName.AxisRef.<br>(Axis information) | LIST_READ_ONLY | The Axis No. (AxisNo) of Axis information (AxisName.AxisRef) that configures the axes group is stored.                                                                                                                                                                                                                                                                                                                                                                                                   |
| BufferingFBs          | Number of buffering FBs    | Operation cycle (GroupEnable) | INT                                                                                                                                                | LIST_READ_ONLY | Displays the number of buffering FBs (0 to 2).                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| CmdInPos              | Command in-position        | Operation cycle               | BOOL                                                                                                                                               | LIST_READ_ONLY | Whether the remaining distance to the target position is equal to or less than Command in-position width (AxesGroupName.Pr.CmdInPos_Width) is displayed. <ul style="list-style-type: none"> <li>FALSE: Equal to or more than Command in-position width</li> <li>TRUE: Less than Command in-position width</li> </ul>                                                                                                                                                                                     |
| CmdInPos_Width        | Command in-position width  | Ready ON                      | LREAL                                                                                                                                              | LIST_READ_ONLY | The command in-position width on the composite axis of the axes group is displayed. The value displayed is the imported setting value of Command in-position width (AxesGroupName.Pr.CmdInPos_Width). When the value of Command in-position width (AxesGroupName.Md.CmdInPos_Width) is "0.0", the command in-position function of the axes group is disabled.                                                                                                                                            |
| CommandedAcceleration | Specified acceleration     | Operation cycle (GroupEnable) | LREAL                                                                                                                                              | LIST_READ_ONLY | The acceleration specified by the user is stored. (Unit: U/s <sup>2</sup> ) When the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)", the specified acceleration/deceleration time is stored. (Unit: s)                                                                                                                                                                                                                                        |
| CommandedDeceleration | Specified deceleration     | Operation cycle (GroupEnable) | LREAL                                                                                                                                              | LIST_READ_ONLY | The deceleration specified by the user is stored. (Unit: U/s <sup>2</sup> ) When the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)", it is an illegal value.                                                                                                                                                                                                                                                                                  |
| CommandedJerk         | Specified jerk             | Operation cycle (GroupEnable) | LREAL                                                                                                                                              | LIST_READ_ONLY | The jerk specified by the user is stored. (Unit: U/s <sup>3</sup> )                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| CommandedVelocity     | Commanded velocity         | Operation cycle (GroupEnable) | LREAL                                                                                                                                              | LIST_READ_ONLY | The commanded velocity imported to the motion related motion control FB being controlled is stored. "0.0" is stored after the control is completed. <ul style="list-style-type: none"> <li>* When Speed mode (VelocityMode) is set to Reference axis speed (ReferenceAxisSpeed) or Long axis speed (LongAxisSpeed) for linear interpolation control, the commanded velocity of the applicable axis is stored.</li> </ul>                                                                                 |
| DecelerationLimit     | Deceleration limit value   | Ready ON                      | LREAL                                                                                                                                              | LIST_READ_ONLY | The deceleration limit value is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Error                 | Axes group error detection | Immediately                   | BOOL                                                                                                                                               | LIST_READ_ONLY | The axes group error status is displayed. <ul style="list-style-type: none"> <li>FALSE: No axes group error</li> <li>TRUE: Axes group error present</li> </ul>                                                                                                                                                                                                                                                                                                                                           |
| ErrorID               | Axes group error code      | Immediately                   | WORD(HEX)                                                                                                                                          | LIST_READ_ONLY | The error code of the axes group error occurred is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| GroupName             | Axes group name            | Immediately                   | WSTRING(127)                                                                                                                                       | LIST_READ_ONLY | The axes group name is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| Variable name              | Name                                                           | Import                           | Data type                                                                                                                                            | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------|----------------------------------------------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GroupStatus                | Axes group status                                              | Operation cycle                  | INT<br>(MC_AXES_GROUP_STATUS)<br> Page 1521<br>MC_AXES_GROUP_STATUS | LIST_READ_ONLY | The axes group status is displayed.<br><ul style="list-style-type: none"> <li>• -1: Axes group variable not initialized/Axes group parameter error (Invalid)</li> <li>• 0: Axes group disabled (GroupDisabled)</li> <li>• 1: Stopping on error (GroupErrorStop)</li> <li>• 2: Decelerating to stop (GroupStopping)</li> <li>• 4: Standby (GroupStandby)</li> <li>• 5: Operating (GroupMoving)</li> </ul>                                                                                                        |
| InterpolationAxes          | Interpolation axes                                             | Operation cycle<br>(GroupEnable) | DWORD(HEX)                                                                                                                                           | LIST_READ_ONLY | The configuration axis that is executing the interpolation control in the axes group is displayed as a bit.                                                                                                                                                                                                                                                                                                                                                                                                     |
| InVelocity                 | Target velocity reached                                        | Operation cycle<br>(GroupEnable) | BOOL                                                                                                                                                 | LIST_READ_ONLY | Whether the set velocity has reached to the target velocity or not is displayed.<br><ul style="list-style-type: none"> <li>• FALSE: Not reached</li> <li>• TRUE: Reached</li> </ul>                                                                                                                                                                                                                                                                                                                             |
| JerkLimit                  | Jerk limit value                                               | Ready ON                         | LREAL                                                                                                                                                | LIST_READ_ONLY | The jerk limit value is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| NumberOfAxes               | Number of configuration axes                                   | Immediately                      | INT                                                                                                                                                  | LIST_READ_ONLY | The number of configuration axes in the axes group is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| OverrunOperation           | Operation setting at overrun                                   | Ready ON                         | INT<br>(MC_DECEL_STOP_MODE)<br> Page 1523<br>MC_DECEL_STOP_MODE     | LIST_READ_ONLY | The input status of the overrun operation setting is displayed.<br><ul style="list-style-type: none"> <li>• 1: Immediate stop (ImmediateStop)</li> </ul>                                                                                                                                                                                                                                                                                                                                                        |
| SetAcceleration            | Set current acceleration                                       | Operation cycle<br>(GroupEnable) | LREAL                                                                                                                                                | LIST_READ_ONLY | The set output acceleration (the acceleration/deceleration calculated from the difference of the set velocity) is stored. (Unit: U/s <sup>2</sup> )<br>The value is positive when acceleration changes in the positive direction (address increasing direction), and the value is negative when acceleration changes in the negative direction (address decreasing direction).<br>The stored value includes an error because a floating-point error occurs.                                                     |
| SetVelocity                | Set velocity                                                   | Operation cycle<br>(GroupEnable) | LREAL                                                                                                                                                | LIST_READ_ONLY | During axes group operation, the set output velocity is stored.<br>The value becomes more than "0.0" regardless of the movement direction of the configuration axis.<br>"0.0" is stored after the control is completed.<br><ul style="list-style-type: none"> <li>* When Speed mode (VelocityMode) is set to Reference axis speed (ReferenceAxisSpeed) or Long axis speed (LongAxisSpeed) for linear interpolation control, the absolute value of the set velocity of the applicable axis is stored.</li> </ul> |
| StopMode_Deceleration      | Deceleration at stop                                           | Ready ON                         | LREAL                                                                                                                                                | LIST_READ_ONLY | The input status of deceleration at stop is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| StopMode_DecelerationCurve | Stop selection at deceleration to stop                         | Ready ON                         | INT<br>(MC_STOP_CURVE_MODE)<br> Page 1523<br>MC_STOP_CURVE_MODE   | LIST_READ_ONLY | The input status of stop selection at deceleration to stop is displayed.<br><ul style="list-style-type: none"> <li>• 1: Recreate deceleration curve (OverrideCurve)</li> </ul>                                                                                                                                                                                                                                                                                                                                  |
| StopMode_ErrorInGroup      | Configuration axis operation selection at axis stop by factors | Ready ON                         | INT<br>(MC_DECEL_STOP_MODE)<br> Page 1523<br>MC_DECEL_STOP_MODE   | LIST_READ_ONLY | The input status of configuration axis operation selection at axis stop by factors is displayed.<br><ul style="list-style-type: none"> <li>• 1: Immediate stop (ImmediateStop)</li> </ul>                                                                                                                                                                                                                                                                                                                       |
| StopMode_General           | Stop selection at stop by factors                              | Ready ON                         | INT<br>(MC_DECEL_STOP_MODE)<br> Page 1523<br>MC_DECEL_STOP_MODE   | LIST_READ_ONLY | The input status of stop selection at stop by factors is displayed.<br><ul style="list-style-type: none"> <li>• 1: Immediate stop (ImmediateStop)</li> <li>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)</li> <li>• 3: Alternative acceleration/deceleration (AlternativeAcc)</li> </ul>                                                                                                                                                                                                         |

| Variable name        | Name                          | Import                        | Data type   | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|-------------------------------|-------------------------------|-------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TargetAcceleration   | Target acceleration           | Operation cycle (GroupEnable) | LREAL       | LIST_READ_ONLY | The maximum acceleration used during acceleration is stored. (Unit: U/s <sup>2</sup> )                                                                                                                                                                                                                                                                                                                                                                                         |
| TargetDeceleration   | Target deceleration           | Operation cycle (GroupEnable) | LREAL       | LIST_READ_ONLY | The maximum deceleration used during deceleration is stored. (Unit: U/s <sup>2</sup> )                                                                                                                                                                                                                                                                                                                                                                                         |
| TargetVelocity       | Target velocity               | Operation cycle (GroupEnable) | LREAL       | LIST_READ_ONLY | The actual target velocity whose override and velocity limit value are considered is stored.<br>The value becomes more than "0.0" regardless of the movement direction of the configuration axis.<br>"0.0" is stored after the control is completed.<br>* When Speed mode (VelocityMode) is set to Reference axis speed (ReferenceAxisSpeed) or Long axis speed (LongAxisSpeed) for linear interpolation control, the target velocity of the applicable axis is stored.        |
| Unit_Position        | Position command unit         | When axes group is valid      | DWORD(HEX)  | LIST_READ_ONLY | The position command unit to be used in the motion control is displayed.<br><ul style="list-style-type: none"> <li>• 00000000H: pulse</li> <li>• 00010000H: m</li> <li>• FD010000H: mm</li> <li>• FA010000H: μm</li> <li>• F7010000H: nm</li> <li>• 00410000H: degree</li> <li>• FD410000H: ×10<sup>-3</sup>degree</li> <li>• FA410000H: ×10<sup>-6</sup>degree</li> <li>• 00B40000H: Revolution</li> <li>• 00C00000H: inch</li> <li>• 00FF0000H: An arbitrary unit</li> </ul> |
| Unit_PositionDisplay | Position command unit display | When axes group is valid      | WSTRING(31) | LIST_READ_ONLY | The currently controlled position command unit is output as a string.                                                                                                                                                                                                                                                                                                                                                                                                          |
| Unit_PositionString  | Position command unit string  | When axes group is valid      | WSTRING(31) | LIST_READ_ONLY | When Position command unit (AxesGroupName.Pr.Unit_Position) is set to "00FF0000H: arbitrary unit", the currently controlled position command unit set in Position command unit string (AxesGroupName.Pr.Unit_PositionString) is displayed as a string.                                                                                                                                                                                                                         |
| Unit_Velocity        | Velocity command unit         | When axes group is valid      | DWORD(HEX)  | LIST_READ_ONLY | The velocity command unit to be used in the motion control is displayed.<br><ul style="list-style-type: none"> <li>• 00000300H: U/s</li> <li>• 00004700H: U/min</li> <li>• FD000300H: U/ms</li> <li>• FA000300H: U/μs</li> <li>• F7000300H: U/ns</li> </ul>                                                                                                                                                                                                                    |
| Unit_VelocityDisplay | Velocity command unit display | When axes group is valid      | WSTRING(31) | LIST_READ_ONLY | The currently controlled velocity command unit is output as a string.                                                                                                                                                                                                                                                                                                                                                                                                          |
| VelocityBias         | Speed bias value              | Ready ON                      | LREAL       | LIST_READ_ONLY | The setting value for Speed bias value (AxesGroupName.Pr.VelocityBias) that was imported during Ready ON is stored.                                                                                                                                                                                                                                                                                                                                                            |
| VelocityLimit        | Velocity limit value          | Ready ON                      | LREAL       | LIST_READ_ONLY | The velocity limit value of the axes group is stored.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| VelocityOverride     | Velocity override factor      | Operation cycle               | LREAL       | LIST_READ_ONLY | The velocity override factor is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Warning              | Axes group warning detection  | Immediately                   | BOOL        | LIST_READ_ONLY | The axis group warning status is displayed.<br><ul style="list-style-type: none"> <li>• FALSE: No axes group warning</li> <li>• TRUE: Axes group warning present</li> </ul>                                                                                                                                                                                                                                                                                                    |
| WarningID            | Axes group warning code       | Immediately                   | WORD(HEX)   | LIST_READ_ONLY | The event code is stored when an axes group warning occurs.                                                                                                                                                                                                                                                                                                                                                                                                                    |

### **AxesGroupName.Cd. (Axes group control data)**

| Variable name        | Name                         | Import          | Data type | Attribute      | Description                                                                                                                                                             |
|----------------------|------------------------------|-----------------|-----------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AccelerationOverride | Acceleration override factor | Operation cycle | LREAL     | LIST_READ_ONLY | The acceleration override factor is set. <ul style="list-style-type: none"><li>• 0.01 to 10.00</li></ul>                                                                |
| ErrorReset           | Axes group error reset       | Service         | BOOL      | LIST_READ_ONLY | TA reset of axes group errors and warnings is requested. <ul style="list-style-type: none"><li>• FALSE: Not executed</li><li>• TRUE: Executes the error reset</li></ul> |
| VelocityOverride     | Velocity override factor     | Operation cycle | LREAL     | LIST_READ_ONLY | The velocity override factor is set. <ul style="list-style-type: none"><li>• 0.00 to 10.00</li></ul>                                                                    |

## System variables

The data type of system variables is expressed as MT\_SYSTEM type.

The system data type has the following members.

| Member name | Data type | Description                                                                                                                                                                                             | Reference                                                          |
|-------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| PrConst     | SYS_CONST | Stores the parameter data (constant) for the system.<br>Opens the setting value at system variable initialization.<br>Does not execute reimporting to the control after system variable initialization. | Page 1475 MotionSystem.PrConst. (Motion system parameter constant) |
| Pr          | SYS_PRM   | Stores the parameter data for the system.<br>Opens the setting value at system variable initialization.<br>The fetch timing to the control changes depending on the parameter.                          | Page 1476 MotionSystem.Pr. (Motion system parameter)               |
| Md          | SYS_MONI  | Stores the monitor data for the system.<br>Executes refresh in the fixed cycle for each monitor data.                                                                                                   | Page 1477 MotionSystem.Md. (Motion system monitor data)            |
| Cd          | SYS_CMD   | Stores the command data for the system. Gets the newest value from each Motion service processing control and uses it for control.                                                                      | Page 1478 MotionSystem.Cd. (Motion system control data)            |

### MotionSystem.PrConst. (Motion system parameter constant)

| Variable name          | Name                              | Import          | Data type                                                                                                                   | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|-----------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ExcludeWarning         | Excluded warning                  | At system start | STRING(255)                                                                                                                 | LIST_WRITE<br>_BACK | A warning that should not be detected is set.<br><ul style="list-style-type: none"> <li>• "": Not set</li> <li>• "0x1000, 0x1001": Will not detect warnings 0x1000, 0x1001.</li> <li>• "0x1000-0x1010": Will not detect warnings 0x1000 to 0x1010.</li> </ul>                                                                                                                              |
| OperationCycle[1]      | Operation cycle setting           | At system start | CYCLE_PARAM<br> Page 1493<br>CYCLE_PARAM | LIST_WRITE<br>_BACK | The first operation cycle setting value is set.<br>Setting and operations specific to Operation cycle setting (OperationCycle[1]) are shown below.<br><b>■Cycle setting (Cycle)</b> <ul style="list-style-type: none"> <li>• 0: Synchronizes with the basic cycle of network</li> </ul>                                                                                                    |
| OperationCycle[2]      | Operation cycle setting           | At system start | CYCLE_PARAM<br> Page 1493<br>CYCLE_PARAM | LIST_WRITE<br>_BACK | The second operation cycle setting value is set.<br>Setting and operations specific to Operation cycle setting (OperationCycle[2]) are shown below.<br><b>■Cycle setting (Cycle)</b> <ul style="list-style-type: none"> <li>• 0: Synchronizes with the middle speed cycle of network</li> </ul>                                                                                            |
| OperationCycle[3]      | Operation cycle setting           | At system start | CYCLE_PARAM<br> Page 1493<br>CYCLE_PARAM | LIST_WRITE<br>_BACK | The third operation cycle setting value is set.<br>Setting and operations specific to Operation cycle setting (OperationCycle[3]) are shown below.<br><b>■Cycle setting (Cycle)</b> <ul style="list-style-type: none"> <li>• 0: Synchronizes with the low speed cycle of network</li> </ul>                                                                                                |
| ProfileRootDrive       | Operation profile data root drive | At system start | WSTRING(7)                                                                                                                  | LIST_WRITE<br>_BACK | The save destination drive of the operation profile data is set.<br><b>■Setting range</b> <ul style="list-style-type: none"> <li>• Data memory (drive 4): /rom</li> <li>• SD memory card (drive 2): /sdc</li> </ul>                                                                                                                                                                        |
| SequenceReadyInterlock | PLC Ready Interlock Selection     | At system start | BOOL                                                                                                                        | LIST_WRITE<br>_BACK | Selects the method to turn on "PLC Ready (MotionSystem.Cd.SequenceReady)".<br> Page 1478 MotionSystem.Cd. (Motion system control data)) <ul style="list-style-type: none"> <li>• TRUE: Interlocking with the CPU function part</li> <li>• FALSE: Not interlocking with the CPU function part</li> </ul> |

## MotionSystem.Pr. (Motion system parameter)

| Variable name            | Name                                       | Import   | Data type                                                                                                                                          | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------|--------------------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ForcedStop_Signal        | All axes forced stop signal                | Ready ON | SIGNAL_SELECT<br> Page 1492<br>SIGNAL_SELECT<br>(Signal select)   | LIST_WRITE<br>_BACK | <p>The signal to use the all axes forced stop is set.</p> <p>It may be regarded as signal detection depending on the variable used as an external signal and the status of devices controlled by the controller.</p> <p>Settings and operations specific to All axes forced stop signal (ForcedStop_Signal) are shown below.</p> <p>■ I/O number (StartIO)</p> <p>Ignores the input value.</p> <p>■ Target (Target)</p> <p>If Target is not specified, the signal is regarded as disabled and the signal non-detection status is always set.</p> <p>The data type that can be specified is only [VAR], [DEV], or [CONST].</p> <p>* If an unusable data type is set, Out of Parameter Range (system) (error code: 1A62H) occurs.</p> <p>When [VAR] or [DEV] is specified, if "Asynchronous" is set for the network synchronous communication setting of the device station referred to, Out of Parameter Range (system) (error code: 1A62H) occurs.</p> <p>■ Signal detection method (Detection)</p> <p>The specification is allowed at the following level detection only. When edge detection specification is set, Out of parameter range (system) (error code: 1A62H) is output.</p> <ul style="list-style-type: none"> <li>• 0: Detection at TRUE (HighLevel)</li> <li>• 1: Detection at FALSE (LowLevel)</li> </ul> <p>■ Compensation time (CompensationTime)</p> <p>Ignores the input value.</p> <p>■ Filter time (FilterTime)</p> <p>The setting range is "0.0 to 5.0 [s]".</p> <p>* If a value outside the range is specified, Out of Filter Time Setting Range of System Signal Warning (event code: 00F0FH) occurs, and the axis operates with 0.0 of the filter time.</p> |
| StopMode_All             | Stop selection at all axes stop by factors | Ready ON | INT<br>(MC_DECEL_STOP_MODE)<br> Page 1523<br>MC_DECEL_STOP_MODE | LIST_WRITE<br>_BACK | <p>Whether to stop immediately or decelerate to stop when an all axes stop cause occurs is set.</p> <ul style="list-style-type: none"> <li>• 1: Immediate stop (ImmediateStop)</li> <li>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)</li> <li>• 3: Alternative acceleration/deceleration (AlternativeAcc)</li> </ul> <p>* Immediate stop will be executed when executing an FB without deceleration specification.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| StopMode_AllDeceleration | Deceleration at all axes stop              | Ready ON | LREAL                                                                                                                                              | LIST_WRITE<br>_BACK | <p>Specifies the deceleration at deceleration stop when an all axes stop cause occurred.</p> <p>Immediate stop will be executed when 0.0000 is set.</p> <p>The setting range differs depending on the acceleration/deceleration method.</p> <p>The acceleration/deceleration method can be selected in "bit0 to 2" of Options (Options) of the motion FB.</p> <p>[Setting range]</p> <ul style="list-style-type: none"> <li>• Acceleration/deceleration specification method: 0.0000, 0.0001 to 2147483647.0</li> <li>• Acceleration/deceleration time-fixed method: 0.0000, 0.000001 to 8400.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## MotionSystem.Md. (Motion system monitor data)

| Variable name            | Name                                       | Import          | Data type                                                                                                                                          | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------|--------------------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Error                    | Motion system error detection              | Immediately     | BOOL                                                                                                                                               | LIST_READ_ONLY | The error status is displayed.<br>• FALSE: No error<br>• TRUE: Error present                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| ErrorID                  | Latest motion system error code            | Immediately     | WORD(HEX)                                                                                                                                          | LIST_READ_ONLY | The latest error code is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| ForcedStop_Released      | Forced stop cancelling                     | Operation cycle | BOOL                                                                                                                                               | LIST_READ_ONLY | The forced stop cancel status is displayed.<br>• FALSE: All axes forced stop<br>• TRUE: All axes forced stop release                                                                                                                                                                                                                                                                                                                                                                                                                    |
| ForcedStop_Signal        | All axes forced stop signal                | Ready ON        | SIGNAL_SELECT<br> Page 1492<br>SIGNAL_SELECT (Signal select)      | LIST_READ_ONLY | The input status of the All axes forced stop signal is displayed.<br>Outputs specific to All axes forced stop signal (ForcedStop_Signal) are shown below.<br>■I/O number (StartIO)<br>"0" is always displayed.<br>■Target (Target)<br>The fetch result of the parameter is displayed.<br>■Signal detection method (Detection)<br>The fetch result of the parameter is displayed.<br>■Compensation time (CompensationTime)<br>"0.0" is always displayed.<br>■Filter time (FilterTime)<br>The fetch result of the parameter is displayed. |
| MotionService            | Motion service processing monitor          | Service         | CYCLE_MONI<br> Page 1493<br>CYCLE_MONI                            | LIST_READ_ONLY | Stores the monitored values of motion service processing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| OperationCycle[1..3]     | Operation cycle monitor                    | Immediately     | CYCLE_MONI<br> Page 1493<br>CYCLE_MONI                          | LIST_READ_ONLY | The monitor values of the first operation cycle, second operation cycle, and third operation cycle are stored.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Ready                    | Ready                                      | Service         | BOOL                                                                                                                                               | LIST_READ_ONLY | The on/off status of Built-in motion ready (X420) is displayed.<br>• FALSE: Off (Not READY)<br>• TRUE: On (READY)                                                                                                                                                                                                                                                                                                                                                                                                                       |
| StopMode_All             | Stop selection at all axes stop by factors | Ready ON        | INT<br>(MC_DECEL_STOP_MODE)<br> Page 1523<br>MC_DECEL_STOP_MODE | LIST_READ_ONLY | The input status of stop selection at all axes stop by factors is displayed.<br>• 1: Immediate stop (ImmediateStop)<br>• 2: Keep current acceleration/deceleration (KeepCurrentAcc)<br>• 3: Alternative acceleration/deceleration (AlternativeAcc)                                                                                                                                                                                                                                                                                      |
| StopMode_AllDeceleration | Deceleration at all axes stop              | Ready ON        | LREAL                                                                                                                                              | LIST_READ_ONLY | The input status of deceleration at all axes stop is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Sync                     | Synchronization flag                       | Service         | BOOL                                                                                                                                               | LIST_READ_ONLY | The on/off status of Synchronization flag (X421) is displayed.<br>• FALSE: Off (Module access disabled)<br>• TRUE: On (Module access enabled)                                                                                                                                                                                                                                                                                                                                                                                           |
| Warning                  | Motion system warning detection            | Immediately     | BOOL                                                                                                                                               | LIST_READ_ONLY | The warning status is displayed.<br>• FALSE: No warning<br>• TRUE: Warning present                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| WarningID                | Latest Motion system warning code          | Immediately     | WORD(HEX)                                                                                                                                          | LIST_READ_ONLY | The latest event code is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## MotionSystem.Cd. (Motion system control data)

| Variable name | Name               | Import  | Data type | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------|--------------------|---------|-----------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ErrorReset    | System error reset | Service | BOOL      | LIST_READ_ONLY | A reset of all errors and warnings is requested.<br><ul style="list-style-type: none"> <li>• FALSE: Not executed</li> <li>• TRUE: Executes the system error reset</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| SequenceReady | PLC ready          | Service | BOOL      | LIST_READ_ONLY | Checks that the CPU function part is normal and displays the signal status to inform the motion function part.<br><ul style="list-style-type: none"> <li>• FALSE: PLC ready OFF</li> <li>• TRUE: PLC ready ON</li> </ul> <p>■When "PLC Ready Interlock Selection (MotionSystem.PrConst.SequenceReadyInterlock)" is TRUE</p> <p>When the following conditions are all satisfied, this variable becomes TRUE.</p> <ul style="list-style-type: none"> <li>• Synchronization flag (X421) turns on.</li> <li>• The status of the CPU function part changes from STOP to PAUSE/RUN.</li> </ul> <p>■When "PLC Ready Interlock Selection (MotionSystem.PrConst.SequenceReadyInterlock)" is FALSE</p> <p>When the following conditions are all satisfied, this variable becomes TRUE.</p> <ul style="list-style-type: none"> <li>• Synchronization flag (X421) turns on.</li> <li>• The status of the CPU function part changes from STOP to PAUSE/RUN.</li> <li>• PLC READY (Y420) turns on.</li> </ul> |



## Input axis variable

The data type of input axis variables to be used for advanced synchronous control is expressed as the ADV\_INPUT type. Each input axis data type has the following members.

| Member name | Data type           | Description                                                                                                                                                                                                                                                                                   | Reference                                                                        |
|-------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| LabelID     | WORD (UINT)         | The input axis label ID is set.                                                                                                                                                                                                                                                               | Page 1479 <a href="#">AdvInputName</a> . (Input axis setting)                    |
| Axis        | AXIS_REF            | The axis to be the input axis for advanced synchronous control is set. An identical axis cannot be specified for multiple input axis information.                                                                                                                                             |                                                                                  |
| PrConst     | ADV_INPUT_PRM_CONST | The parameter data (constant) of the axis to be the input axis is stored. The setting value at the input axis variable initialization is opened. Reload to the control is not executed after the input axis variable initialization.                                                          | Page 1480 <a href="#">AdvInputName.PrConst</a> . (Input axis parameter constant) |
| Pr          | ADV_INPUT_PRM       | The parameter data of the axis to be the input axis is stored. The default value at the input axis variable initialization is opened. Reload to the control is not executed after the input axis variable initialization. The fetch timing to the control changes depending on the parameter. | Page 1480 <a href="#">AdvInputName.Pr</a> . (Input axis parameter)               |
| Md          | ADV_INPUT_MONI      | The monitor data of the axis to be the input axis is stored. Refresh in the fixed cycle is executed for each monitor data.                                                                                                                                                                    | Page 1480 <a href="#">AdvInputName.Md</a> . (Input axis monitor data)            |

### AdvInputName. (Input axis setting)

| Variable name | Name             | Import          | Data type                                                                                                                                                         | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------|------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LabelID       | Axis label ID    | At system start | WORD (UINT)                                                                                                                                                       | LIST_WRITE<br>_BACK | The input axis label ID is set.<br>• 1 to 256                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Axis          | Axis information | At system start | AXIS_REF<br> Page 1444<br><a href="#">AxisName.AxisRef</a> . (Axis information) | LIST_WRITE<br>_BACK | Axis information ( <a href="#">AxisName.AxisRef</a> ) of an axis to be the input axis for advanced synchronous control is set. The maximum number of input axes that can be generated is 256. An identical axis cannot be set for the axis information on different input axes. If it is set, Advanced Synchronous Control Input Axis Incorrect (error code: 1A0EH) will occur. Do not set Axis information ( <a href="#">AxisName.AxisRef</a> ) to an axis defined with a local label. Doing so prevents the input axis from being generated. |

## AdvInputName.PrConst. (Input axis parameter constant)

| Variable name                 | Name                             | Import          | Data type                                                                                                                                        | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------|----------------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SourceValue                   | Data source selection            | At system start | INT<br>(MC_SOURCE)<br> Page 1520<br>MC_SOURCE                   | LIST_WRITE<br>_BACK | The data source of the input axis to be referenced in advanced synchronous control is set.<br><ul style="list-style-type: none"> <li>• 1: Set value (mcSetValue)</li> <li>• 2: Actual value (mcActualValue)</li> <li>• 101: Latest set value (mcLatestSetValue)</li> <li>• 102: Latest actual value (mcLatestActualValue)</li> </ul>                                                                                                                    |
| SmoothingTimeConstant         | Smoothing time constant          | At system start | WORD (UINT)                                                                                                                                      | LIST_WRITE<br>_BACK | The averaging time for smoothing the input movement amount from the input axis is set.<br><ul style="list-style-type: none"> <li>• 0 to 5000 [ms]</li> </ul>                                                                                                                                                                                                                                                                                            |
| PhaseCompensationTimeConstant | Phase compensation time constant | At system start | WORD (UINT)                                                                                                                                      | LIST_WRITE<br>_BACK | The time constant at which the phase compensation amount during phase compensation is reflected with a primary delay is set.<br>63% of the phase compensation amount is reflected with the set time constant.<br><ul style="list-style-type: none"> <li>• 0 to 65535 [ms]</li> </ul>                                                                                                                                                                    |
| DirectionRestriction          | Moving direction restriction     | At system start | INT<br>(MC_INPUT_DIRECTION)<br> Page 1526<br>MC_INPUT_DIRECTION | LIST_WRITE<br>_BACK | This variable is set when the input movement amount from the input axis needs to be restricted to one direction.<br><ul style="list-style-type: none"> <li>• 0: No moving direction restriction (NoDirectionRestriction)</li> <li>• 1: Allowed only when the current position is in the increasing direction (mcPositiveDirection)</li> <li>• 2: Allowed only when the current position is in the decreasing direction (mcNegativeDirection)</li> </ul> |

## AdvInputName.Pr. (Input axis parameter)

| Variable name                | Name                                | Import          | Data type | Attribute           | Description                                                                                                                                                                           |
|------------------------------|-------------------------------------|-----------------|-----------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PhaseCompensationAdvanceTime | Phase compensation advancement time | Operation cycle | DINT      | LIST_WRITE<br>_BACK | This variable is set when the input axis phrase (input response) needs to be advanced or delayed.<br><ul style="list-style-type: none"> <li>• -100000000 to 100000000 [μs]</li> </ul> |

## AdvInputName.Md. (Input axis monitor data)

| Variable name              | Name                                | Import          | Data type | Attribute          | Description                                                                                                                                                                                                                                                                                                 |
|----------------------------|-------------------------------------|-----------------|-----------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ActiveStatus               | Enable state                        | Immediately     | INT       | LIST_READ<br>_ONLY | The input axis status is stored.<br><ul style="list-style-type: none"> <li>• -1: Invalid</li> <li>• 0: Not connected</li> <li>• 1: Input axis invalid</li> </ul>                                                                                                                                            |
| CumulativePosition         | Cumulative current position         | Operation cycle | LREAL     | LIST_READ<br>_ONLY | The position unit of the input axis whose cumulative current position is set to Axis information (AdvInputName.Axis) on the input axis is set.<br>The current position of the input axis is a value after smoothing processing, phase compensation processing, and moving direction restriction processing. |
| SetVelocity                | Set velocity                        | Operation cycle | LREAL     | LIST_READ<br>_ONLY | The speed unit of the input axis whose speed is set to Axis information (AdvInputName.Axis) on the input axis is stored.<br>The speed of the input axis is a value after smoothing processing, phase compensation processing, and moving direction restriction processing.                                  |
| PhaseCompensationAmount    | Phase compensation amount           | Operation cycle | LREAL     | LIST_READ<br>_ONLY | The position command unit of the input axis whose phase compensation amount is set to Axis information (AdvInputName.Axis) on the input axis is stored.<br>The phase compensation amount of the input axis is a value after smoothing processing and phase compensation processing.                         |
| DirectionRestrictionAmount | Moving direction restriction amount | Operation cycle | LREAL     | LIST_READ<br>_ONLY | The position unit of the axis whose cumulative value of the input movement amount in the direction opposite to the permitted direction is set to the input axis when the moving direction of the input axis is restricted is stored.                                                                        |

## Output axis variable

The data type of output axis variables to be used for advanced synchronous control is expressed as the ADV\_OUTPUT type. Each output axis data type has the following members.

| Member name | Data type            | Description                                                                                                                                                                                                                                                                                  | Reference                                                                 |
|-------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| LabelID     | WORD (UINT)          | The output axis label ID is set.                                                                                                                                                                                                                                                             | Page 1481 <u>AdvOutputName</u> . (Output axis setting)                    |
| AxisRef     | AXIS_REF             | The axis to be the output axis for advanced synchronous control is set. An identical axis cannot be specified for multiple output axis information.                                                                                                                                          |                                                                           |
| PrConst     | ADV_OUTPUT_PRM_CONST | The parameter data (constant) of the axis to be the output axis is stored. The setting value at the output axis variable initialization is opened. Reload to the control is not executed after the output axis variable initialization.                                                      | Page 1482 <u>AdvOutputName.PrConst</u> . (Output axis parameter constant) |
| Pr          | ADV_OUTPUT_PRM       | The parameter data of the axis to be the output axis is stored. The default value at the output axis variable initialization is opened. Reload to the control is executed after the output axis variable initialization. The fetch timing to the control changes depending on the parameter. | Page 1483 <u>AdvOutputName.Pr</u> . (Output axis parameter)               |
| Md          | ADV_OUTPUT_MONI      | The monitor data of the axis to be the output axis is stored. Refresh in the fixed cycle is executed for each monitor data.                                                                                                                                                                  | Page 1485 <u>AdvOutputName.Md</u> . (Output axis monitor data)            |
| Cd          | ADV_OUTPUT_CMD       | The output axis control command data is stored. The latest value is acquired for every control operation cycle and used for the control.                                                                                                                                                     | Page 1485 <u>AdvOutputName.Cd</u> . (Output axis control data)            |

### AdvOutputName. (Output axis setting)

| Variable name | Name             | Import          | Data type                                                                                                                                                 | Attribute        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------|------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LabelID       | Axis label ID    | At system start | WORD (UINT)                                                                                                                                               | LIST_WRITE _BACK | The output axis label ID is set.<br>• 1 to 256                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Axis          | Axis information | At system start | AXIS_REF<br> Page 1444<br><u>AxisName.AxisRef</u> . (Axis information) | LIST_WRITE _BACK | Axis information ( <u>AxisName.AxisRef</u> ) of an axis to be the output axis for advanced synchronous control is set. The maximum number of output axes that can be generated is 256. An identical axis cannot be set for the axis information on different output axes. If it is set, Advanced Synchronous Control Output Axis Incorrect (error code: 1A0FH) will occur. Do not set Axis information ( <u>AxisName.AxisRef</u> ) to an axis defined with a local label. Doing so prevents the output axis from being generated. The axis types that can be set as output axes are real drive axes, virtual drive axes, and virtual linked axes. If an unavailable axis is set, Advanced Synchronous Control Output Axis Incorrect (error code: 1A0FH) will occur. |

## AdvOutputName.PrConst. (Output axis parameter constant)

| Variable name                              | Name                                                     | Import          | Data type   | Attribute       | Description                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------|----------------------------------------------------------|-----------------|-------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SmoothingTimeConstant                      | Output axis smoothing time constant                      | At system start | WORD (UINT) | LIST_WRITE_BACK | The averaging time [ms] for smoothing the output movement amount from the output axis is set.<br>• 0 to 5000 [ms]                                                                                                                                                                                                                                    |
| MasterClutchSmoothingTimeConstant          | Master axis clutch smoothing time constant               | At system start | WORD (UINT) | LIST_WRITE_BACK | The time constant is set when Master axis clutch smoothing method ( <u>AdvOutputName.Pr.Clutch.MasterSmoothingMethod</u> ) is set to "1: Time constant method (exponent) (TimeConstantExponent)" or "2: Time constant method (linear) (TimeConstantLinear)".<br>The time constant to be set is common to both clutch on and off.<br>• 0 to 5000 [ms] |
| AuxClutchSmoothingTimeConstant             | Auxiliary axis clutch smoothing time constant            | At system start | WORD (UINT) | LIST_WRITE_BACK | The time constant is set when Auxiliary axis clutch smoothing method ( <u>AdvOutputName.Pr.Clutch.AuxSmoothingMethod</u> ) is set to "1: Time constant method (exponent) (TimeConstantExponent)" or "2: Time constant method (linear) (TimeConstantLinear)".<br>The time constant to be set is common to both clutch on and off.<br>• 0 to 5000 [ms] |
| MasterSpeedChangeGearSmoothingTimeConstant | Master axis speed change gear smoothing time constant    | At system start | WORD (UINT) | LIST_WRITE_BACK | The averaging time to smooth the speed change during master axis speed change processing is set. Note that the smoothing process delays the input value transmission for the setting time.<br>When the setting value is "0", the speed changes directly.<br>• 0 to 5000 [ms]                                                                         |
| AuxSpeedChangeGearSmoothingTimeConstant    | Auxiliary axis speed change gear smoothing time constant | At system start | WORD (UINT) | LIST_WRITE_BACK | The averaging time to smooth the speed change during auxiliary axis speed change processing is set. Note that the smoothing process delays the input value transmission for the setting time.<br>When the setting value is "0", the speed changes directly.<br>• 0 to 5000 [ms]                                                                      |
| OutSpeedChangeGearSmoothingTimeConstant    | Output axis speed change gear smoothing time constant    | At system start | WORD (UINT) | LIST_WRITE_BACK | The averaging time to smooth the speed change during output axis speed change processing is set. Note that the smoothing process delays the input value transmission for the setting time.<br>When the setting value is "0", the speed changes directly.<br>• 0 to 5000 [ms]                                                                         |

## AdvOutputName.Pr. (Output axis parameter)

| Variable name         | Name                                  | Import   | Data type                                                                                                                                           | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------|---------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SubAxis               | Sub-input axis target                 | At start | AXIS_REF<br> Page 1444<br>AxisName.AxisRef. (Axis information)     | LIST_WRITE<br>_BACK | The target axis of the sub-input axis is set.<br>This variable is invalid when set to "0".<br>If an axis that has not been assigned to the input settings is set, Advanced synchronization control axis unset (error code: 1B22H) occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| AuxAxis               | Auxiliary axis target                 | At start | AXIS_REF<br> Page 1444<br>AxisName.AxisRef. (Axis information)     | LIST_WRITE<br>_BACK | The target axis of the auxiliary axis is set.<br>This variable is invalid when set to "0".<br>If an axis that has not been assigned to the input settings is set, Advanced synchronization control axis unset (error code: 1B22H) occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Gear                  | Gear parameter                        | At start | ADV_GEAR_PARAM<br> Page 1507<br>ADV_GEAR_PARAM<br>(Gear parameter) | LIST_WRITE<br>_BACK | The gear function parameters are set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| MasterOnClutchSignal  | Master axis ON clutch signal setting  | At start | SIGNAL_SELECT<br> Page 1492<br>SIGNAL_SELECT<br>(Signal select)    | LIST_WRITE<br>_BACK | The external signal of the clutch is set when Master axis ON clutch control setting<br>(AdvOutputName.Pr.Clutch.MasterOnControl) is "15: I/O data specification (ClutchSignal)".<br>Settings and operations specific to Master axis ON clutch signal setting (MasterOnClutchSignal) are shown below.<br>■Target (Target)<br>Data type can only be set to [OBJ], [VAR], [DEV], and [LINK].<br>■Signal detection method (Detection)<br>Allows detection at the following setting level only.<br>• 2: Detection at FALSE → TRUE (rising edge) (RisingEdge)<br>• 3: Detection at TRUE → FALSE (falling edge) (FallingEdge)<br>• 4: Detection at rising edge/falling edge (BothEdges)<br>■Compensation time (CompensationTime)<br>The setting range is "-5.0 to 5.0 [s]".<br>■Filter time (FilterTime)<br>The setting range is "0.0".     |
| MasterOffClutchSignal | Master axis OFF clutch signal setting | At start | SIGNAL_SELECT<br> Page 1492<br>SIGNAL_SELECT<br>(Signal select)  | LIST_WRITE<br>_BACK | The external signal of the clutch is set when Master axis OFF clutch control setting<br>(AdvOutputName.Pr.Clutch.MasterOffControl) is "15: I/O data specification (ClutchSignal)".<br>Settings and operations specific to Master axis OFF clutch signal setting (MasterOffClutchSignal) are shown below.<br>■Target (Target)<br>Data type can only be set to [OBJ], [VAR], [DEV], and [LINK].<br>■Signal detection method (Detection)<br>Allows detection at the following setting level only.<br>• 2: Detection at FALSE → TRUE (rising edge) (RisingEdge)<br>• 3: Detection at TRUE → FALSE (falling edge) (FallingEdge)<br>• 4: Detection at rising edge/falling edge (BothEdges)<br>■Compensation time (CompensationTime)<br>The setting range is "-5.0 to 5.0 [s]".<br>■Filter time (FilterTime)<br>The setting range is "0.0". |

| Variable name      | Name                                           | Import   | Data type                                                                                              | Attribute       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------|------------------------------------------------|----------|--------------------------------------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AuxOnClutchSignal  | Auxiliary axis ON clutch signal setting        | At start | SIGNAL_SELECT<br>☞ Page 1492<br>SIGNAL_SELECT (Signal select)                                          | LIST_WRITE_BACK | <p>The external signal of the clutch is set when Auxiliary axis ON clutch control setting (AdvOutputName.Pr.Clutch.AuxOnControl) is "15: I/O data specification (ClutchSignal)".</p> <p>Settings and operations specific to Auxiliary axis ON clutch signal setting (AuxOnClutchSignal) are shown below.</p> <p>■Target (Target)<br/>Data type can only be set to [OBJ], [VAR], [DEV], and [LINK].</p> <p>■Signal detection method (Detection)<br/>Allows detection at the following setting level only.</p> <ul style="list-style-type: none"> <li>• 2: Detection at FALSE → TRUE (rising edge) (RisingEdge)</li> <li>• 3: Detection at TRUE → FALSE (falling edge) (FallingEdge)</li> <li>• 4: Detection at rising edge/falling edge (BothEdges)</li> </ul> <p>■Compensation time (CompensationTime)<br/>The setting range is "-5.0 to 5.0 [s]".</p> <p>■Filter time (FilterTime)<br/>The setting range is "0.0".</p>     |
| AuxOffClutchSignal | Auxiliary axis OFF clutch signal setting       | At start | SIGNAL_SELECT<br>☞ Page 1492<br>SIGNAL_SELECT (Signal select)                                          | LIST_WRITE_BACK | <p>The external signal of the clutch is set when Auxiliary axis OFF clutch control setting (AdvOutputName.Pr.Clutch.AuxOffControl) is "15: I/O data specification (ClutchSignal)".</p> <p>Settings and operations specific to Auxiliary axis OFF clutch signal setting (AuxOffClutchSignal) are shown below.</p> <p>■Target (Target)<br/>Data type can only be set to [OBJ], [VAR], [DEV], and [LINK].</p> <p>■Signal detection method (Detection)<br/>Allows detection at the following setting level only.</p> <ul style="list-style-type: none"> <li>• 2: Detection at FALSE → TRUE (rising edge) (RisingEdge)</li> <li>• 3: Detection at TRUE → FALSE (falling edge) (FallingEdge)</li> <li>• 4: Detection at rising edge/falling edge (BothEdges)</li> </ul> <p>■Compensation time (CompensationTime)<br/>The setting range is "-5.0 to 5.0 [s]".</p> <p>■Filter time (FilterTime)<br/>The setting range is "0.0".</p> |
| Clutch             | Clutch parameter                               | —        | ADV_CLUTCH_PARAM<br>☞ Page 1508<br>ADV_CLUTCH_PARAM (Clutch parameter)                                 | LIST_WRITE_BACK | The clutch function parameters are set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| SpeedChangeGear    | Speed change gear parameter                    | —        | ADV_SPEEDCHANGEGEAR_PARAM<br>☞ Page 1514<br>ADV_SPEEDCHANGEGEAR_PARAM (Speed change gear parameter)    | LIST_WRITE_BACK | The speed change gear function parameters are set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Cam                | Cam parameter                                  | —        | ADV_CAM_PARAM<br>☞ Page 1515<br>ADV_CAM_PARAM (Cam parameter)                                          | LIST_WRITE_BACK | The cam function parameters are set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Restore            | Synchronous control initial position parameter | —        | ADV_RESTORE_PARAM<br>☞ Page 1518<br>ADV_RESTORE_PARAM (Synchronous control initial position parameter) | LIST_WRITE_BACK | The synchronous control initial position parameters are set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

### AdvOutputName.Md. (Output axis monitor data)

| Variable name | Name               | Import      | Data type                                                                                                                                          | Attribute      | Description                                                                                                                                                                                                                     |
|---------------|--------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SyncStatus    | Synchronous status | Immediately | INT                                                                                                                                                | LIST_READ_ONLY | The output axis synchronous status is stored.<br>• -1: Invalid<br>• 0: Unsynchronized<br>• 1: Synchronized                                                                                                                      |
| MasterAxisNo  | Master axis        | At start    | WORD (UINT)                                                                                                                                        | LIST_READ_ONLY | The axis number of the master axis that is set to Axis information ( <u>AdvInputName.Axis</u> ) on the input axis that is in synchronization with the output axis is stored. If no connection is established, "0" is stored.    |
| SubAxisNo     | Sub-input axis     | At start    | WORD (UINT)                                                                                                                                        | LIST_READ_ONLY | The axis number of the sub-input axis that is set to Axis information ( <u>AdvInputName.Axis</u> ) on the input axis that is in synchronization with the output axis is stored. If no connection is established, "0" is stored. |
| AuxAxisNo     | Auxiliary axis     | At start    | WORD (UINT)                                                                                                                                        | LIST_READ_ONLY | The axis number of the auxiliary axis that is set to Axis information ( <u>AdvInputName.Axis</u> ) on the input axis that is in synchronization with the output axis is stored. If no connection is established, "0" is stored. |
| Clutch        | Clutch monitor     | —           | ADV_CLUTCH_MONI<br> Page 1512<br>ADV_CLUTCH_MONI (Clutch monitor) | LIST_READ_ONLY | The monitor data of the clutch function is stored.                                                                                                                                                                              |
| Cam           | Cam monitor        | —           | ADV_CAM_MONI<br> Page 1516<br>ADV_CAM_MONI (Cam monitor)          | LIST_READ_ONLY | The monitor data of the cam function is stored.                                                                                                                                                                                 |

### AdvOutputName.Cd. (Output axis control data)

| Variable name   | Name                           | Import | Data type                                                                                                                                                                                    | Attribute       | Description                                         |
|-----------------|--------------------------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------------------------------------|
| Clutch          | Clutch control data            | —      | ADV_CLUTCH_CMD<br> Page 1512<br>ADV_CLUTCH_CMD (Clutch control data)                                      | LIST_READ_ONLY  | The clutch function control data is set.            |
| SpeedChangeGear | Speed change gear control data | —      | ADV_SPEEDCHANG<br>EGEAR_CMD<br> Page 1514<br>ADV_SPEEDCHANG<br>EGEAR_CMD (Speed change gear control data) | LIST_WRITE_BACK | The speed change gear function control data is set. |
| Cam             | Cam control data               | —      | ADV_CAM_CMD<br> Page 1517<br>ADV_CAM_CMD (Cam control data)                                               | LIST_READ_ONLY  | The control data of the cam function is set.        |

## System variable (Advanced synchronous control)

The data type of system variables is expressed as SYSTEM type.

The system data type has the following members.

| Member name | Data type | Description                                                                                                                                                                                             | Reference                                                         |
|-------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| PrConst     | SYS_CONST | Stores the parameter data (constant) for the system.<br>Opens the setting value at system variable initialization.<br>Does not execute reimporting to the control after system variable initialization. | Page 1486 AddonSystem.PrConst. (Add-on system parameter constant) |
| Md          | SYS_MONI  | Stores the monitor data for the system.<br>Executes refresh in the fixed cycle for each monitor data.                                                                                                   | Page 1486 AddonSystem.Md. (Add-on system monitor data)            |

### AddonSystem.PrConst. (Add-on system parameter constant)

| Variable name                 | Name                                        | Import          | Data type                                                                                                                 | Attribute       | Description                                                                                     |
|-------------------------------|---------------------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------------------|
| MT_MotionControl_AdvancedSync | Add-on MotionControl_AdvancedSync parameter | At system start | ADDON_PARAM<br> Page 1493<br>ADDON_PARAM | LIST_WRITE_BACK | The maximum usage of the memory used by the add-on MotionControl_AdvancedSync parameter is set. |

### AddonSystem.Md. (Add-on system monitor data)

| Variable name                 | Name                                      | Import  | Data type                                                                                                               | Attribute      | Description                                                                                     |
|-------------------------------|-------------------------------------------|---------|-------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------------|
| MT_MotionControl_AdvancedSync | Add-on MotionControl_AdvancedSync monitor | Service | ADDON_MONI<br> Page 1493<br>ADDON_MONI | LIST_READ_ONLY | The free space of the memory used by the add-on MotionControl_AdvancedSync parameter is stored. |



## Other structure variables

### MC\_CAM\_REF

| Variable name | Name    | Data type                                | Description                            |
|---------------|---------|------------------------------------------|----------------------------------------|
| ProfileData   | Profile | PROFILE_DATA<br>📖 Page 1492 PROFILE_DATA | The profile of the cam data is set.    |
| CamID         | Cam ID  | MC_CAM_ID<br>📖 Page 1487 MC_CAM_ID       | The profile ID of the cam data is set. |

### MC\_POSITIONING\_DATA\_REF

| Variable name   | Name             | Data type                                                    | Description                                   |
|-----------------|------------------|--------------------------------------------------------------|-----------------------------------------------|
| ProfileData     | Profile          | PROFILE_DATA<br>📖 Page 1492 PROFILE_DATA                     | The profile of the positioning data is set.   |
| PositioningData | Positioning data | MC_POSITIONING_DATA_ID<br>📖 Page 1487 MC_POSITIONING_DATA_ID | The ID number of the positioning data is set. |

### MC\_CAM\_ID

| Variable name | Name       | Data type                            | Description                            |
|---------------|------------|--------------------------------------|----------------------------------------|
| ProfileID     | Profile ID | PROFILE_ID<br>📖 Page 1492 PROFILE_ID | The profile ID of the cam data is set. |

### MC\_POSITIONING\_DATA\_ID

| Variable name | Name       | Data type                            | Description                                              |
|---------------|------------|--------------------------------------|----------------------------------------------------------|
| ProfileData   | Profile ID | PROFILE_ID<br>📖 Page 1492 PROFILE_ID | The operation profile ID of the positioning data is set. |

### MC\_TRIGGER\_REF

| Variable name | Name           | Data type                                                  | Description                |
|---------------|----------------|------------------------------------------------------------|----------------------------|
| Signal        | Trigger signal | SIGNAL_SELECT<br>📖 Page 1492 SIGNAL_SELECT (Signal select) | The trigger signal is set. |

### MC\_INPUT\_REF

| Variable name | Name         | Data type                                                  | Description              |
|---------------|--------------|------------------------------------------------------------|--------------------------|
| Signal        | Input signal | SIGNAL_SELECT<br>📖 Page 1492 SIGNAL_SELECT (Signal select) | The input signal is set. |

### MC\_OUTPUT\_REF

| Variable name | Name          | Data type                                                  | Description               |
|---------------|---------------|------------------------------------------------------------|---------------------------|
| Signal        | Output signal | SIGNAL_SELECT<br>📖 Page 1492 SIGNAL_SELECT (Signal select) | The output signal is set. |

### MC\_CAMSWITCH\_REF

| Variable name | Name            | Data type                                                  | Description                                     |
|---------------|-----------------|------------------------------------------------------------|-------------------------------------------------|
| ProfileData   | Profile         | PROFILE_DATA<br>📖 Page 1492 PROFILE_DATA                   | The profile of the digital cam switch is set.   |
| CamSwitchData | Cam switch data | MC_CAMSWITCH_DATA_REF<br>📖 Page 1488 MC_CAMSWITCH_DATA_REF | The ID number of the digital cam switch is set. |

## MC\_TRACK\_REF

| Variable name   | Name                        | Data type | Description                                                                                                                                                                                          |
|-----------------|-----------------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OnCompensation  | ON time compensation        | LREAL     | The timing when the output signal turns on is compensated.                                                                                                                                           |
| OffCompensation | OFF time compensation       | LREAL     | The timing when the output signal turns off is compensated.                                                                                                                                          |
| Hysteresis      | Switching disabled distance | LREAL     | The distance within which switching is prohibited by the data source is set.<br>When the data source increases or decreases near the switching point, the chattering of output signals is prevented. |

## MC\_CAMSWITCH\_DATA\_REF

| Variable name | Name       | Data type                                                                                                            | Description                                                      |
|---------------|------------|----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| ProfileData   | Profile ID | PROFILE_ID<br> Page 1492 PROFILE_ID | The operation profile ID of the digital cam switch is specified. |

## MC\_CAMSWITCH\_SOURCE\_REF

| Variable name        | Name                                       | Data type                                                                                                                              | Description                                                                                                                                                  |
|----------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source               | Data source                                | TARGET_REF<br> Page 1489 TARGET_REF<br>(Input signal) | A data source is specified.                                                                                                                                  |
| RingCount_LowerValue | Data source ring counter lower limit value | LREAL                                                                                                                                  | The data source ring counter lower limit value is set.                                                                                                       |
| RingCount_UpperValue | Data source ring counter upper limit value | LREAL                                                                                                                                  | The data source ring counter upper limit value is set.                                                                                                       |
| SpeedAverageNum      | Number of speed averaging times            | WORD (UINT)                                                                                                                            | To calculate the on/off timing of the switch, set until which previous operation cycles to include for average speed calculation, counting from the present. |

## TARGET\_REF (Input signal)

| Variable name | Name   | Data type   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------|--------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| StartIO       | IO No. | WORD(HEX)   | The I/O No. is set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Target        | Target | WSTRING(63) | <p>The signal used in control is set with the following string formats.</p> <ul style="list-style-type: none"> <li>* The setting is not case-sensitive. In addition, spaces are ignored.</li> </ul> <p>■[Classification](Type)Data name.Bit position@Target modification</p> <ul style="list-style-type: none"> <li>• [Classification]<sup>*1</sup></li> <li>• (Type)<sup>*2</sup></li> <li>• Data name<sup>*1</sup></li> <li>• Bit position<sup>*3</sup></li> <li>• @Target modification<sup>*4</sup></li> </ul> <p>■[Classification](Data type)WSTRING type label<sup>^</sup></p> <ul style="list-style-type: none"> <li>• [Classification]<sup>*1</sup></li> <li>• (Type)<sup>*2</sup></li> <li>• WSTRING type label<sup>*8</sup></li> </ul> |

\*1 The data classification is set in "[Classification]", and the target data is set in "Data name". The method for setting the data name differs depending on the set classification.

| Classification | Target                                                                      | Data name                            |                                                                                                                                                                                                                                                                                                                                                                                        | Setting example                                                                                        |
|----------------|-----------------------------------------------------------------------------|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
|                |                                                                             | Format                               | Description                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                        |
| [OBJ]          | CANopen object of the device station (which has been mapped to cyclic data) | [OBJ]0x□□□□**##                      | <p>Sets the index, subindex, and size of the object.</p> <ul style="list-style-type: none"> <li>• □□□□: Index</li> <li>• **: Subindex</li> <li>• ##: Size (in bits)</li> </ul> <p>* Match the (type) setting with the object size.</p> <p>* Some of the objects can be used as an external signal high-accuracy input.</p> <p>* An object whose size is "1 byte" is not available.</p> | <p>[OBJ]0x607A0020</p> <p>* For an MR-J5(W)-G Target position (Obj.607Ah: 00h) 4 byte object (20H)</p> |
| [VAR]          | Label of the Motion system                                                  | [VAR]Label name                      | <p>Sets a label in the Motion system.</p> <p>* When setting a local label, set the POU name in "@Target modification".</p>                                                                                                                                                                                                                                                             | [VAR]ADUnit10.OutputEnable                                                                             |
| [AXIS]         | Axis data                                                                   | [AXIS]MC_SOURCE                      | <p>Sets an MC_SOURCE enumeration type enumerator. Only the data type "LREAL" can be set.</p> <ul style="list-style-type: none"> <li>• 1: Set value (mcSetValue)</li> <li>• 2: Actual value (mcActualValue)</li> <li>• 101: Latest set value (mcLatestSetValue)</li> <li>• 102: Latest actual value (mcLatestActualValue)</li> </ul> <p>* This data cannot be written.</p>              | [AXIS]mcSetValue                                                                                       |
| [DEV]          | Device in the Motion system (Including link device of the module itself)    | [DEV]Data name                       | <p>Sets a device in the module itself. For details on settable devices, refer to the following.</p> <p>☞ Page 1491 List of supported devices for [DEV] type</p>                                                                                                                                                                                                                        | <p>[DEV]X10</p> <p>[DEV]U1\G11500000.1</p>                                                             |
| [CONST]        | Constant                                                                    | [CONST]Constant<br>[CONST]0xConstant | <p>Sets a floating decimal (E format is also available), decimal integer, or hexadecimal integer.</p> <p>* This data cannot be written.</p>                                                                                                                                                                                                                                            | <p>[CONST]1000</p> <p>[CONST]0x100</p>                                                                 |

\*2 This is written when explicitly setting the data type. The following data types can be set.  
When "(BOOL)" is specified for data set in Classification having a data type other than BOOL type, it will be handled as though 0 was specified for the specification target bit number.

| Type    |
|---------|
| (BOOL)  |
| (INT)   |
| (DINT)  |
| (WORD)  |
| (DWORD) |
| (REAL)  |
| (LREAL) |

\*3 When the bit position is added to data of the [Classification] shown below, the data is handled as though it is BOOL type.  
When (Type) and the bit position are both set, the setting for (Type) is ignored and the data becomes BOOL type data.

| Classification                                          | Bit position setting range |
|---------------------------------------------------------|----------------------------|
| [OBJ]                                                   | 0 to F                     |
| [VAR] (only WORD type, DWORD type, INT type, DINT type) |                            |
| [DEV]                                                   |                            |

\*4 The auxiliary information used for specifying the data is set. The details differ depending on the set [Classification].  
Certain functions that use signals require the target modification to be set. When specifying the target modification for data types and functions that do not require it, the specification will be ignored.

| Classification | Target modification                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Setting example                                         |
|----------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
|                | Format                                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                         |
| [OBJ]          | @Station address                      | <p>Sets the station address (IP address to identify the device station).<br/>When multiple logic axes are included in one station such as with a multi-axis drive unit, set multi-drop numbers to identify certain logic axes.</p> <p>@192.168.3.10#2</p> <p>* The multi-drop No. is set as "# + No. (decimal)".</p> <ul style="list-style-type: none"> <li>• #0: A-axis</li> <li>• #1: B-axis</li> <li>• #2: C-axis</li> </ul> <p>* The multi-drop No. can be omitted. When it is omitted, it is regarded as "#0".</p> | <p>@192.168.3.10<br/>@192.168.3.10#2</p>                |
| [VAR]          | @POU name                             | <p>The POU name is set when setting local labels.<br/>When @POU is not written, the data is handled as a global label regardless of the setting which uses the same label name for a global label and a local label.</p>                                                                                                                                                                                                                                                                                                |                                                         |
| [AXIS]         | @Position@CumulativePos               | <p>Sets the target data (position).<br/>@Position and @CumulativePos are set with the MC_SOURCE type enumerator set in "Data name".*5</p>                                                                                                                                                                                                                                                                                                                                                                               | <p>@Position<br/>@CumulativePos</p>                     |
| [DEV]          | —                                     | The target modification cannot be set. It is ignored if set.                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                         |
| [CONST]        | @+adding value<br>@-subtracting value | <p>Used to change the read value each time the value is referred.<br/>Setting the target modification allows the value to be changed each cycle.<br/>When the data type is REAL or LREAL, this setting is invalid.</p>                                                                                                                                                                                                                                                                                                  | <p>[CONST](INT)0@-10*6<br/>[CONST](BOOL)0x00.3@+1*7</p> |

\*5 The following enumerators can be set.

○: Can be set, ×: Cannot be set

| MC_SOURCE type enumerator                      | Description                              | Modification |                |
|------------------------------------------------|------------------------------------------|--------------|----------------|
|                                                |                                          | @Position    | @CumulativePos |
| 1: Set value (mcSetValue)                      | Set value of previous operation cycle    | ○            | ○              |
| 2: Actual value (mcActualValue)                | Actual value of previous operation cycle | ○            | ×              |
| 101: Latest set value (mcLatestSetValue)       | Set value of latest operation cycle      | ○            | ○              |
| 102: Latest actual value (mcLatestActualValue) | Actual value of latest operation cycle   | ○            | ×              |

\*6 The referred value will be as "0, -10, -20, -30, ...".

\*7 The referred value switches between TRUE/FALSE every eight (2<sup>3</sup>) cycles. (Adds 1 byte value "+1" every cycle, then retrieves the status of bit 3.)  
Values from 0 to 7 can be used for bit specification for [CONST].

\*8 When setting to a format with more than 63 characters, use WSTRING type labels and use the following method to perform the setting.  
(1) Declare the WSTRING type global label in the Motion system, and store the following portion: Data name.Bit position@Target modification.  
(2) Set the label name from (1) as the WSTRING type label of TARGET\_REF. (Add "^" to the end of the name to indicate reference.)

## ■List of supported devices for [DEV] type

A list of supported devices for [DEV] type is shown below.

R: Only read is available, RW: Read and write are available, —: Not supported

| Device type                     | Device name                                 | Symbol | Supported          |
|---------------------------------|---------------------------------------------|--------|--------------------|
| User device                     | Input                                       | X      | RW <sup>*1,2</sup> |
|                                 | Direct access input                         | DX     | —                  |
|                                 | Output                                      | Y      | RW <sup>*1,2</sup> |
|                                 | Direct access output                        | DY     | —                  |
|                                 | Internal relay                              | M      | RW <sup>*2</sup>   |
|                                 | Latch relay                                 | L      | RW <sup>*2</sup>   |
|                                 | Link relay                                  | B      | RW <sup>*2</sup>   |
|                                 | Link special relay                          | SB     | RW <sup>*2</sup>   |
|                                 | Annunciator                                 | F      | R                  |
|                                 | Edge relay                                  | V      | —                  |
|                                 | Timer                                       | T      | R <sup>*3</sup>    |
|                                 | Retentive timer                             | ST     | R <sup>*3</sup>    |
|                                 | Long timer                                  | LT     | R <sup>*3</sup>    |
|                                 | Long retentive timer                        | LST    | R <sup>*3</sup>    |
|                                 | Counter                                     | C      | R <sup>*3</sup>    |
|                                 | Long counter                                | LC     | R <sup>*3</sup>    |
|                                 | Data register                               | D      | RW <sup>*2</sup>   |
|                                 | Link register                               | W      | RW <sup>*2</sup>   |
|                                 | Link special register                       | SW     | RW <sup>*2</sup>   |
| System device                   | Special relay                               | SM     | RW                 |
|                                 | Special register                            | SD     | RW                 |
|                                 | Function input                              | FX     | —                  |
|                                 | Function output                             | FY     | —                  |
|                                 | Function register                           | FD     | —                  |
| File register                   | File register                               | R      | —                  |
|                                 |                                             | ZR     | —                  |
| Index register                  | Index register                              | Z      | —                  |
|                                 | (32-bit index modification)                 | (ZZ)   | —                  |
|                                 | Long index register                         | LZ     | —                  |
| Pointer                         | Pointer                                     | P      | —                  |
|                                 | Interrupt pointer                           | I      | —                  |
| Module access device            | Module access device                        | Un\G   | RW <sup>*4</sup>   |
| CPU buffer memory access device | CPU buffer memory access device             | U3E0\G | RW <sup>*5</sup>   |
| Refresh data register           | Refresh data register                       | RD     | —                  |
| Nesting                         | Nesting                                     | N      | —                  |
| Others                          | Network No. specification device            | J      | —                  |
|                                 | Intelligent module No. specification device | U      | —                  |

\*1 Only unassigned devices can be used.

\*2 When the device is set as a refresh target in refresh settings, whether the device station is connected is monitored. For the operation when the device station is disconnected, refer to the following.

 User's manual for the controller used

When the device is set as a refresh target in "Refresh Settings", the signals available are only those of devices whose "Network Synchronous Communication" is set to "Synchronous".

\*3 Timer, retentive timer, long timer, long retentive timer, counter, and long counter have a contact (S), coil (C), and current value (N). When specifying them as the data name, specify as follows: Contact: "Device symbol S", Coil: "Device symbol C", Current value: "Device symbol N"

To specify the contact of retentive timer ST10 to the data name: [DEV]STS10

To specify the current value of long counter LC10 to the data name: [DEV]LCN10

When using timer, retentive timer, long timer, long retentive timer, counter, or long counter, specify the type in accordance with the device size.

\*4 Supported only when the buffer memory of the motion function part or CC-Link IE TSN function part of the controller is specified.

\*5 Supported only when the CPU buffer memory of the controller is specified.

## SIGNAL\_SELECT (Signal select)

| Variable name    | Name                    | Data type                                                                                                                               | Description                                                                                                                                                                                                                                                                                                                                                          |
|------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source           | Signal                  | TARGET_REF<br> Page 1489 TARGET_REF (Input signal)     | BOOL type signals used in control are set.<br>For Source (Signal), only the following data classifications can be set.<br><ul style="list-style-type: none"> <li>• [OBJ] (which has been mapped to cyclic data)</li> <li>• [VAR]</li> <li>• [DEV]</li> <li>• [CONST]</li> </ul>                                                                                      |
| Detection        | Signal detection method | INT<br>(MC_SIGNAL_LOGIC)<br> Page 1524 MC_SIGNAL_LOGIC | The signal logic is set.<br><ul style="list-style-type: none"> <li>• 0: Detection at TRUE (HighLevel)</li> <li>• 1: Detection at FALSE (LowLevel)</li> <li>• 2: Detection at FALSE → TRUE (rising edge) (RisingEdge)</li> <li>• 3: Detection at TRUE → FALSE (falling edge) (FallingEdge)</li> <li>• 4: Detection at rising edge/falling edge (BothEdges)</li> </ul> |
| CompensationTime | Compensation time       | LREAL                                                                                                                                   | The compensation time of the I/O signal is set in units of seconds.<br>* The setting range differs for each function.                                                                                                                                                                                                                                                |
| FilterTime       | Filter time             | LREAL                                                                                                                                   | The filter time for removing chattering of the I/O signal is set in units of seconds.<br>* The setting range differs for each function.                                                                                                                                                                                                                              |

## PROFILE\_DATA

| Variable name | Name                                    | Data type                                                                                                                  | Description                                                              |
|---------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Location      | Operation profile data storage location | FILE_LOCATION<br> Page 1492 FILE_LOCATION | The file name and storage location of the operation profile data is set. |
| ID            | Profile ID                              | PROFILE_ID<br> Page 1492 PROFILE_ID     | The profile ID No. of the operation profile data is set.                 |

## FILE\_LOCATION

| Variable name | Name                 | Data type   | Description                                                                                            |
|---------------|----------------------|-------------|--------------------------------------------------------------------------------------------------------|
| FileName      | File name            | WSTRING(63) | The file name is set.<br>(Up to 63 characters including the extension can be set.)* <sup>1</sup>       |
| Path          | Folder specification | WSTRING(63) | The folder path in which the file is stored is set.<br>(Up to 63 characters can be set.)* <sup>1</sup> |

\*<sup>1</sup> Set the total character amount for File name (FileName) and Folder specification (Path) to within 127 characters (including null).

## PROFILE\_ID

| Variable name | Name           | Data type  | Description                                                                                  |
|---------------|----------------|------------|----------------------------------------------------------------------------------------------|
| Number        | Profile ID No. | WORD(UINT) | The profile ID No. is set.<br><ul style="list-style-type: none"> <li>• 0 to 60000</li> </ul> |
| StartIO       | I/O number     | WORD       | The I/O No. is set.                                                                          |

## CYCLE\_PARAM

| Variable name                | Name                                    | Data type                                                                                                                                | Description                                                                                                                                                                                                                                  |
|------------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NumOfCycleOverWngDetectTimes | Number of cycle over warning detections | WORD(UINT)                                                                                                                               | The number of cycles until the cycle over warning of each cycle is detected can be set.<br>Warning is not detected when 0 is set.<br>When a value outside the range is set, operation is performed with the default value.<br>• 0 to 5 times |
| NumOfCycleOverErrDetectTimes | Number of cycle over error detections   | WORD(UINT)                                                                                                                               | The number of cycles until the cycle over error of each cycle is detected can be set.<br>When a value outside the range is set, operation is performed with the default value.<br>• 1 to 5 times                                             |
| CycleOverErrorType           | Cycle over error selection              | INT<br>(MC_ERROR_CLASS)<br> Page 1524<br>MC_ERROR_CLASS | The assignment of the over error for each cycle is set.<br>• 2: Minor Error (MinorError)<br>• 3: Moderate Error (ModerateError)                                                                                                              |

## CYCLE\_MONI

| Variable name         | Name                    | Data type    | Description                                                                |
|-----------------------|-------------------------|--------------|----------------------------------------------------------------------------|
| ProcessingTime        | Processing time         | DWORD(UDINT) | The processing time of each cycle is stored in units of [ns].              |
| MaximumProcessingTime | Maximum processing time | DWORD(UDINT) | The maximum processing time of each cycle is stored in units of [ns].      |
| Cycle                 | Setting cycle           | DWORD(UDINT) | The cycle setting of each cycle is stored in units of [ns].                |
| CycleOver             | Cycle over              | BOOL         | This variable becomes TRUE when the cycle over is detected for each cycle. |

## ADDON\_PARAM

| Variable name    | Name                    | Data type    | Description                                                                                 |
|------------------|-------------------------|--------------|---------------------------------------------------------------------------------------------|
| RamSizeMax       | Maximum RAM size        | DWORD(UDINT) | The maximum amount [K byte] of system memory (RAM) used in the add-ons is set.              |
| BackupRamSizeMax | Maximum backup RAM size | DWORD(UDINT) | The maximum amount [K byte] of system memory (backup RAM) being used in the add-ons is set. |

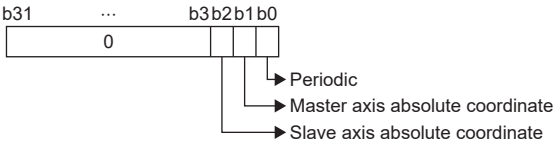
## ADDON\_MONI

| Variable name     | Name                     | Data type    | Description                                                                                    |
|-------------------|--------------------------|--------------|------------------------------------------------------------------------------------------------|
| RamUsage          | RAM usage                | DWORD(UDINT) | The current amount [K byte] of system memory (RAM) being used in the add-ons is stored.        |
| RamMaxUsage       | RAM usage maximum        | DWORD(UDINT) | The maximum amount [K byte] of system memory (RAM) being used in the add-ons is stored.        |
| BackupRamUsage    | Backup RAM usage         | DWORD(UDINT) | The current amount [K byte] of system memory (backup RAM) being used in the add-ons is stored. |
| BackupRamMaxUsage | Backup RAM usage maximum | DWORD(UDINT) | The maximum amount [K byte] of system memory (backup RAM) being used in the add-ons is stored. |
| Version           | Version                  | STRING(15)   | The version information of the add-ons is stored.                                              |

## INSTANCE\_ID

| Variable name | Name        | Data type  | Description                    |
|---------------|-------------|------------|--------------------------------|
| StartIO       | IO No.      | WORD(HEX)  | The I/O No. is set.            |
| Number        | Instance ID | WORD(UINT) | The instance ID number is set. |

## PROFILE\_CAM\_DATA

| Variable name     | Name (device offset)                      | Data type    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------|-------------------------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Interpolate       | Specifying interpolation method (+0)      | INT          | The specifying interpolation method for the cam data is set.<br><ul style="list-style-type: none"> <li>• 0: Linear interpolation</li> <li>• 1: Specifying for each section</li> <li>• 2: Spline interpolation</li> </ul>                                                                                                                                                                                                                                                                                                                                                                       |
| Resolution        | Resolution (+2)                           | DWORD(UDINT) | The cam resolution amount for one cycle is set.<br><ul style="list-style-type: none"> <li>• 8 to 65535</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| InputUnitString   | Input unit string (+4)                    | WSTRING(31)  | The unit for input data is set as a string.<br>When omitted, the setting is handled as "pulse".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| OutputUnitString  | Output unit string (+36)                  | WSTRING(31)  | The unit for output data is set as a string.<br>When omitted, the setting is handled as "pulse".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| StartPoint        | Start point* <sup>1</sup> (+68)           | LREAL        | The start point is set.<br>Set "0.0".<br>* If a value other than "0.0" is set, Operation Profile Data Incorrect (error code: 1B8FH) occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| StartStroke       | Initial stroke amount* <sup>1</sup> (+72) | LREAL        | The stroke amount for the start point is set.<br>$(-\text{Stroke amount (Stroke)} \leq \text{Initial stroke amount (StartStroke)} \leq \text{Stroke amount (Stroke)})$<br><ul style="list-style-type: none"> <li>• -100.0000000 to 100.0000000</li> </ul>                                                                                                                                                                                                                                                                                                                                      |
| StartVelocity     | Initial velocity* <sup>2</sup> (+76)      | LREAL        | The velocity for the start point is set.<br><ul style="list-style-type: none"> <li>• -2500000000.0 &lt; Initial velocity (StartVelocity) ≤ 2500000000.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                             |
| StartAcceleration | Initial acceleration* <sup>2</sup> (+80)  | LREAL        | The acceleration for the start point is set.<br><ul style="list-style-type: none"> <li>• -2147483647.0 &lt; Initial acceleration (StartAcceleration) ≤ 2147483647.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                 |
| CycleLength       | Length per cycle* <sup>1</sup> (+84)      | LREAL        | The input amount that is required for one cycle is set.<br>$(0.00000000000001 \leq \text{Length per cycle (CycleLength)} \leq 10000000000.0)$<br><ul style="list-style-type: none"> <li>• 0.00000000000001 to 10000000000.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                         |
| CycleMin          | Minimum value per cycle (+88)             | LREAL        | The minimum value per cycle is set.<br>Set "0.0".<br>* If a value other than "0.0" is set, Operation Profile Data Incorrect (error code: 1B8FH) occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| CycleMax          | Maximum value per cycle (+92)             | LREAL        | The maximum value per cycle is set.<br>$(\text{Minimum value per cycle (CycleMin)} < \text{Maximum value per cycle (CycleMax)} \leq 10000000000.0)$<br><ul style="list-style-type: none"> <li>• -10000000000.0 to 10000000000.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                     |
| CycleTime         | Time per cycle* <sup>2</sup> (+96)        | LREAL        | The time per cycle is set.<br>$(0.001 < \text{Time per cycle (CycleTime)} \leq 100000.0)$<br><ul style="list-style-type: none"> <li>• 0.001 to 100000.000</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Stroke            | Stroke amount (+100)                      | LREAL        | The stroke amount is set.<br>$(0.00000000000001 \leq \text{Stroke amount (Stroke)} \leq 10000000000.0)$<br><ul style="list-style-type: none"> <li>• 0.00000000000001 to 10000000000.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                               |
| NumberOfSections  | Number of sections* <sup>1</sup> (+104)   | DWORD(UDINT) | The number of sections for the cam data is set.<br><b>■When set to "1: Specifying for each section"</b><br><ul style="list-style-type: none"> <li>• 1 to 360</li> </ul> <b>■When set to "2: Spline interpolation"</b><br><ul style="list-style-type: none"> <li>• 3 to 360</li> </ul> * When set to "0: Linear interpolation", this variable is not used. It is ignored if set.                                                                                                                                                                                                                |
| Options           | Options (+106)                            | DWORD(H EX)  | Options are set in the specified bit position.<br><br><b>■Periodic (Bit 0)</b><br><ul style="list-style-type: none"> <li>• 0: Non periodic</li> <li>• 1: Periodic</li> </ul> <b>■Master axis absolute coordinate (Bit 1)</b><br><ul style="list-style-type: none"> <li>• 0: Relative coordinate</li> </ul> <b>■Slave axis absolute position (Bit 2)</b><br><ul style="list-style-type: none"> <li>• 0: Relative coordinate</li> <li>• 1: Absolute coordinate</li> </ul> *For bit 3 to bit 31, specify "0". |

\*1 When Specifying interpolation method (Interpolate) is set to "0: Linear interpolation", this variable is not used. It is ignored if set.

\*2 Only used when the cam curve is "12: 5th curve (Adjustment) (FifthCurve\_SpeedDesignation)". It is ignored for other curves.



## PROFILE\_CAM\_ELEMENT

| Variable name   | Name<br>(device offset)                                                    | Data type                                                                                                                                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CurveType       | Cam curve type<br>(+0)                                                     | INT<br>(MC_CAM_CURV<br>E_TYPE)<br> Page 1522<br>MC_CAM_CURV<br>E_TYPE | The cam curve is set.<br><ul style="list-style-type: none"> <li>• 0: Constant Velocity (ConstantSpeed)</li> <li>• 1: Constant acceleration (ConstantAcceleration)</li> <li>• 2: Distorted trapezoid (DistortedTrapezoid)</li> <li>• 3: Distorted sine (DistortedSine)</li> <li>• 4: Distorted constant speed (DistortedConstantSpeed)</li> <li>• 5: Cycloid (Cycloid)</li> <li>• 6: 5th curve (FifthCurve)</li> <li>• 7: Trapecloid (Trapecloid)</li> <li>• 8: Reverse trapezoid (ReverseTrapezoid)</li> <li>• 9: Double hypotenuse (DoubleHypotenuse)</li> <li>• 10: Reverse double hypotenuse (ReverseDoubleHypotenuse)</li> <li>• 11: Single hypotenuse (SingleHypotenuse)</li> <li>• 12: 5th curve (Adjustment) (FifthCurve_SpeedDesignation)</li> </ul> |
| EndPoint        | End point <sup>*1</sup><br>(+4)                                            | LREAL                                                                                                                                                  | The position (the current value per cycle) to the length per cycle is set.<br><ul style="list-style-type: none"> <li>• <math>0.0 &lt; \text{End point (EndPoint)} \leq \text{Length per cycle (CycleLength)}</math></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Stroke          | Stroke<br>(+8)                                                             | LREAL                                                                                                                                                  | The stroke position is set.<br><ul style="list-style-type: none"> <li>• <math>\text{Absolute value of Stroke (Stroke)} \leq \text{Stroke amount (Stroke)}</math></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| RangeP1         | Curve application range<br>(P1)<br>(+12)                                   | LREAL                                                                                                                                                  | Set the curve applicable range (start point: P1, end point: P2) for the cam curve.<br>Set this variable within the range of "P1 < P2". Note that when "P1 = P2 = 0", "P1 = 0" and "P2 = 1" are applied.<br><ul style="list-style-type: none"> <li>• 0.0 to 1.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| RangeP2         | Curve application range<br>(P2)<br>(+16)                                   | LREAL                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| RangeL1         | Acceleration/<br>deceleration range<br>compensation (Range<br>L1)<br>(+20) | LREAL                                                                                                                                                  | The acceleration/deceleration range (L1, L2) for the cam curve is set.<br>The range that can be set differs depending on the cam curve.<br>When "L1 = L2 = 0.0000", the default value for each cam curve is applied.<br>The setting value is ignored for curves that do not use L1 or L2.<br><ul style="list-style-type: none"> <li>• <math>0.0001 &lt; \text{Range (L1, L2)} &lt; 1.0000</math></li> </ul>                                                                                                                                                                                                                                                                                                                                                  |
| RangeL2         | Acceleration/<br>deceleration range<br>compensation (Range<br>L2)<br>(+24) | LREAL                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| EndVelocity     | End point velocity <sup>*2</sup><br>(+28)                                  | LREAL                                                                                                                                                  | The end point velocity of the cam curve is set.<br><ul style="list-style-type: none"> <li>• <math>-25000000000.0 &lt; \text{End point velocity (EndVelocity)} &lt; 25000000000.0</math></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| EndAcceleration | End point acceleration <sup>*2</sup><br>(+32)                              | LREAL                                                                                                                                                  | The end point acceleration of the cam curve is set.<br><ul style="list-style-type: none"> <li>• <math>-2147483647.0 &lt; \text{End point acceleration (EndAcceleration)} &lt; 2147483647.0</math></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

\*1 When the end point exceeds the length per cycle before reaching the final section, the section number at the time is determined as the final section number and the end point is overwritten with the length per cycle.

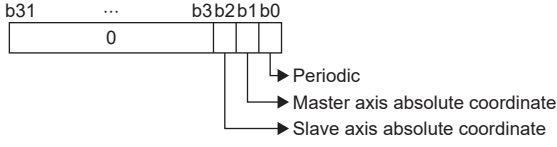
\*2 The setting items used to read/write differ depending on Specifying interpolation method of the operation profile data.

## PROFILE\_ROTARY\_CUTTER

| Variable name         | Name (device offset)                         | Data type    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------|----------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Resolution            | Resolution (+0)                              | DWORD(UDINT) | The resolution of the generated cam is set.<br>• 8 to 32768                                                                                                                                                                                                                                                                                                                                                                                                                          |
| InputUnitString       | Input unit string (+2)                       | WSTRING(31)  | The input unit string is set.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Options               | Options (+34)                                | DWORD(HEX)   | Options are set in the specified bit position.<br><div style="text-align: center;"> </div> <p> <b>■Periodic (Bit 0)</b><br/>           • 0: Non periodic<br/>           • 1: Periodic<br/> <b>■Master axis absolute coordinate (Bit 1)</b><br/>           • 0: Relative coordinate<br/> <b>■Slave axis absolute position (Bit 2)</b><br/>           • 0: Relative coordinate<br/>           • 1: Absolute coordinate<br/>           * For bit 3 to bit 31, specify "0".         </p> |
| AutoGenerationOptions | Auto-generation option (+36)                 | WORD(HEX)    | The auto-generation options are set in the specified bit position.<br><div style="text-align: center;"> </div> <p> <b>■Acceleration/deceleration method (Bit 0)</b><br/>           • 0: Trapezoidal acceleration/deceleration<br/>           • 1: S-curve acceleration/deceleration<br/> <b>■Synchronous axis length setting (Bit 1)</b><br/>           • 0: Diameter<br/>           • 1: Cycle length<br/>           * For bits 2 to 15, specify "0".         </p>                  |
| NumberOfCutter        | Number of cutters (+37)                      | WORD(UINT)   | The number of cutters is set.<br>• Setting range: 1 to 256                                                                                                                                                                                                                                                                                                                                                                                                                           |
| SyncSectionAccRatio   | Synchronous section acceleration ratio (+40) | LREAL        | Set this variable to precisely adjust the synchronous speed in the synchronous section.<br>The value becomes "Synchronous section speed = Synchronous speed × (100% + Acceleration ratio)".<br>• -50.0 to 50.0                                                                                                                                                                                                                                                                       |
| SheetLength           | Sheet length (+44)                           | LREAL        | The sheet length is set.<br>(0.0 < Sheet length (SheetLength) ≤ 10000000000.0)<br>• 0.00000000000001 to 10000000000.0                                                                                                                                                                                                                                                                                                                                                                |
| SheetSyncWidth        | Sheet synchronization width (+48)            | LREAL        | The sheet synchronization width (seal width) is set.<br>When the synchronous speed section for retracting operation is required in front of and behind the sheet synchronization width, add the retracting width.<br>(0.0 < Sheet synchronization width (SheetSyncWidth) < Sheet length (SheetLength))<br>(0.0 < Sheet synchronization width (SheetSyncWidth) < Cycle length/Number of cutters (NumberOfCutter))<br>• 0.00000000000001 to 10000000000.0                              |
| SyncAxisLength        | Synchronous axis length (+52)                | LREAL        | The rotary cutter axis length is set.<br><b>■When Auto-generation options is set to "0: Diameter"</b><br>Calculated as "Cycle length = setting value × π".<br><b>■When Auto-generation options is set to "1: Cycle length"</b><br>Calculated as "Cycle length = setting value".<br>(0.0 < Cycle length < 10000000000.0)<br>• 0.00000000000001 to 10000000000.0                                                                                                                       |

| Variable name          | Name (device offset)                  | Data type | Description                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|---------------------------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SyncPositionAdjustment | Synchronous position adjustment (+56) | LREAL     | The position adjustment value of the synchronous section is set.<br>Negative value: The synchronous section is adjusted to the sheet start side.<br>0: The center of the sheet is in the synchronous section.<br>Positive value: The synchronous section is adjusted to the sheet end side.<br>(Absolute value of Synchronous position adjustment (SyncPositionAdjustment) < Sheet length (SheetLength) / 2)<br>• -10000000000.0 to 10000000000.0 |
| AccDecWidth            | Acceleration/deceleration width (+60) | LREAL     | The sheet width (one side) of the acceleration/deceleration area is set.<br>When a negative value is set, the acceleration/deceleration width is calculated to be the maximum.<br>(2 × Acceleration/deceleration width (AccDecWidth) ≤ Sheet length (SheetLength) - Sheet synchronization width (SheetSyncWidth))<br>• -10000000000.0 to 10000000000.0                                                                                            |
| AsyncSpd               | Asynchronous speed result (+64)       | LREAL     | When the auto-generation is successfully completed, the asynchronous speed is stored as the ratio of the synchronous speed.                                                                                                                                                                                                                                                                                                                       |

## PROFILE\_CAMSWITCH\_DATA

| Variable name            | Name (device offset)                 | Data type     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------|--------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InputUnitString          | Input unit string (+0)               | WSTRING (31)  | The unit for input data is set as a string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| NumberOfSwitches         | Number of switches (+32)             | DWORD (UDINT) | The total number of switches is specified.<br>• 1 to 10000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Options                  | Options (+34)                        | DWORD(HEX)    | Options are set in the specified bit position.<br>Set bits 3 to 31 to "0".<br><br> <ul style="list-style-type: none"> <li>■ Periodic (Bit 0)<sup>*1</sup> <ul style="list-style-type: none"> <li>• 0: Non periodic</li> <li>• 1: Periodic</li> </ul> </li> <li>■ Master axis absolute coordinate (bit 1)<sup>*1</sup> <ul style="list-style-type: none"> <li>• 0: Relative coordinate</li> <li>• 1: Absolute coordinate</li> </ul> </li> <li>■ Slave axis absolute position (Bit 2)<sup>*1</sup> <ul style="list-style-type: none"> <li>• 0: Relative coordinate</li> <li>• 1: Absolute coordinate</li> </ul> </li> </ul> |
| ReferenceSpeed           | Reference speed (+36)                | LREAL         | This setting is not used. Set 0.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| ReferenceSpeedUnitString | Reference speed unit string (+40)    | WSTRING (31)  | This setting is not used. Leave it empty.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| RingCount_LowerValue     | Ring counter lower limit value (+72) | LREAL         | The ring counter lower limit value is set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| RingCount_UpperValue     | Ring counter upper limit value (+76) | LREAL         | The ring counter upper limit value is set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

\*1 Specify "1".

## PROFILE\_CAMSWITCH\_ELEMENT

| Variable name   | Name (device offset)       | Data type | Description                                                                                                                           |
|-----------------|----------------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------|
| FirstOnPosition | ON start position (+0)     | LREAL     | The lower limit position or the start position to turn on the switch is set.<br>• -10000000000.0 to 10000000000.0                     |
| LastOnPosition  | ON end position (+4)       | LREAL     | The upper limit position to turn on the switch is set.<br>• -10000000000.0 to 10000000000.0                                           |
| Direction       | Direction selection (+8)   | INT       | The direction of the input to turn on the switch is set.<br>• 0: Both direction<br>• 1: Positive direction<br>• 2: Negative Direction |
| CamSwitchMode   | Switch mode selection (+9) | INT       | The specification method for the ON condition is set.<br>• 0: Switch disabled<br>• 1: Position reference                              |
| Duration        | ON time (+12)              | LREAL     | This setting is not used. The setting value is ignored.                                                                               |

## PROFILE\_POSITIONING\_DATA

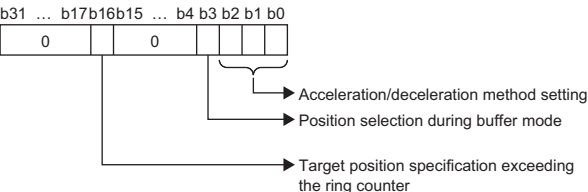
| Variable name        | Name (device offset)                     | Data type   | Description                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------|------------------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NumberOfDataSettings | Number of positioning data settings (+0) | WORD (UINT) | The number of positioning data is set.<br>Set the value so that Number of positioning data settings (NumberOfDataSettings) is equal to or less than Total number of positioning data (TotalNumberOfData).<br>• 0 to 5000<br>If a value out of range or exceeding the total number of positioning data is set, Operation profile data incorrect (error code: 1B8FH) occurs when the value is applied. |
| TotalNumberOfData    | Total number of positioning data (+1)    | WORD (UINT) | The total number of positioning data is set.<br>The maximum value of the positioning data numbers to be set in application or writing is set.<br>• 1 to 5000<br>If a value out of range is set, Operation profile data incorrect (error code: 1B8FH) occurs when the value is applied.                                                                                                               |
| Options              | Options (+2)                             | DWORD (HEX) | The options are set.<br>Set "00000000H".                                                                                                                                                                                                                                                                                                                                                             |

## PROFILE\_POSITIONING\_DATA\_ELEMENT

| Variable name    | Name (device offset)         | Data type                                                                                                                                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DataNo           | Positioning data number (+0) | WORD (UINT)                                                                                                                                         | The index number of the positioning data is set.<br>The positioning data is executed in the order of Positioning data numbers (DataNo).<br>The positioning data is set so that Positioning data numbers (DataNo) are sorted in ascending order.<br>• 1 to Total number of positioning data (5000)                                                                                                                                                                                                                                  |
| OperationPattern | Operation pattern (+1)       | INT (MC_OPERATION_PATTERN)<br> Page 1525<br>MC_OPERATION_PATTERN | The operation pattern of the positioning data is set.<br>Whether to execute positioning data numbers successively or terminate the process is set.<br>• 0: Positioning Complete (PositioningComplete)<br>• 1: Continuous Positioning (ContinuousPositioning)<br>• 2: Continuous Path (BlendingLow) (ContinuousBlendingLow)<br>• 3: Continuous Path (BlendingPrevious) (ContinuousBlendingPrevious)<br>• 4: Continuous Path (BlendingNext) (ContinuousBlendingNext)<br>• 5: Continuous Path (BlendingHigh) (ContinuousBlendingHigh) |

| Variable name      | Name<br>(device offset)                              | Data type                                                                                                                                         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ControlMethod      | Control method<br>(+2)                               | INT<br>(MC_CONTROL_METHOD)<br> Page 1525<br>MC_CONTROL_METHOD    | The control method for positioning data numbers is set.<br><ul style="list-style-type: none"> <li>• 0080H: NOP (NOP)</li> <li>• 0082H: JUMP (JUMP)</li> <li>• 0083H: LOOP (LOOP)</li> <li>• 0084H: LEND (LEND)</li> <li>• 0101H: Absolute Value Linear Interpolation (LinearAbsolute)</li> <li>• 0102H: Relative Value Linear Interpolation (LinearRelative)</li> <li>• 0103H: Absolute Value Circular Interpolation (CircularAbsolute)</li> <li>• 0104H: Relative Value Circular Interpolation (CircularRelative)</li> <li>• 0105H: Absolute Value Helical Interpolation (HelicalAbsolute)</li> <li>• 0106H: Relative Value Helical Interpolation (HelicalRelative)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| InterpolationAxis1 | Interpolation axis 1<br>(+3)                         | WORD (UINT)                                                                                                                                       | An interpolation axis that performs interpolation control from among the structuring axes in the axes group is set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| InterpolationAxis2 | Interpolation axis 2<br>(+4)                         | WORD (UINT)                                                                                                                                       | Set the linear interpolation axes of linear interpolation and the circular interpolation axes of circular interpolation by the setting of control method (ControlMethod).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| InterpolationAxis3 | Interpolation axis 3<br>(+5)                         | WORD (UINT)                                                                                                                                       | For configuration axes to be specified as interpolation axes, different configuration axes and different number of interpolation axes can be set for each positioning data. However, note that if the specified configuration axis or the number of interpolation axes differs between the continuous path data and the next positioning data, the speed of each axis may suddenly change when the positioning data is switched.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| InterpolationAxis4 | Interpolation axis 4<br>(+6)                         | WORD (UINT)                                                                                                                                       | <ul style="list-style-type: none"> <li>• 1 to 16</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| CircMode           | Circular interpolation mode<br>(+7)                  | INT<br>(MC_CIRC_MODE)<br> Page 1521<br>MC_CIRC_MODE              | The circular interpolation control specification method is set.<br><ul style="list-style-type: none"> <li>• 0: Border point specification (mcBorder)</li> <li>• 1: Center point specification (mcCenter)</li> <li>• 2: Radius specification (mcRadius)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| CircPathChoice     | Path selection<br>(+8)                               | INT<br>(MC_CIRC_PATHCHOICE)<br> Page 1521<br>MC_CIRC_PATHCHOICE | The rotation direction for circular interpolation control is set.<br><ul style="list-style-type: none"> <li>• 0: CW (mcCW)</li> <li>• 1: CCW (mcCCW)</li> <li>• 2: Shortcut (mcShortWay)</li> <li>• 3: Detour (mcLongWay)</li> <li>• 4: CW Detour (mcCWLongWay)</li> <li>• 5: CCW Detour (mcCCWLongWay)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Reserve1 [0..2]    | Reserve 1<br>(+9)                                    | WORD (UINT)                                                                                                                                       | Not used (For offset adjustment)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Position1          | Target position/movement amount/end point 1<br>(+12) | LREAL                                                                                                                                             | The following settings are applied according to the Control method (ControlMethod) setting.<br><Linear interpolation>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Position2          | Target position/movement amount/end point 2<br>(+16) | LREAL                                                                                                                                             | For the target position/movement amount/end points 1 to 4 (Position1 to Position4), the target positions and movement amounts of the structuring axes set for the interpolation axes 1 to 4 (InterpolationAxis1 to InterpolationAxis4) are set.<br><ul style="list-style-type: none"> <li>• -10000000000.0 to 10000000000.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Position3          | Target position/movement amount/end point 3<br>(+20) | LREAL                                                                                                                                             | "0" or the target position/movement amount/end points 1 to 4 (Position1 to Position4) corresponding to the omitted interpolation axes 1 to 4 (InterpolationAxis1 to InterpolationAxis4) can be omitted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Position4          | Target position/movement amount/end point 4<br>(+24) | LREAL                                                                                                                                             | <p>■When "0101H: Absolute Value Linear Interpolation (LinearAbsolute)" is set<br/>The target position of the absolute position is set.</p> <p>■When "0102H: Relative Value Linear Interpolation (LinearRelative)" is set<br/>The movement amount from the current position at execution of positioning data is set.</p> <p>&lt;Circular interpolation&gt;<br/>For the target position/movement amount/end points 1 and 2 (Position1 and Position2), the target positions and movement amounts of the structuring axes set for the interpolation axes 1 and 2 (InterpolationAxis1 and InterpolationAxis2) are set.<br/> <ul style="list-style-type: none"> <li>• -10000000000.0 to 10000000000.0</li> </ul> The target position/movement amount/end points 3 and 4 (Position3 and Position4) can be omitted. (The setting is ignored.)</p> <p>■When "0103H: Absolute Value Circular Interpolation (CircularAbsolute)" is set<br/>The end point of the absolute position is set.</p> <p>■When "0104H: Relative Value Circular Interpolation (CircularRelative)" is set<br/>The movement amount from the current position at execution of positioning data to the end point is set.</p> |

| Variable name      | Name<br>(device offset)                         | Data type                                                                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------|-------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Direction1         | Direction selection 1<br>(+28)                  | INT<br>(MC_DIRECTION)<br>☞ Page 1520<br>MC_DIRECTION                           | The direction used to move from the current position to the target position during linear interpolation control is set.<br>The direction is set when "0101H: Absolute Value Linear Interpolation (LinearAbsolute)" is set for the Control method (ControlMethod).                                                                                                                                                                                                 |
| Direction2         | Direction selection 2<br>(+29)                  | INT<br>(MC_DIRECTION)<br>☞ Page 1520<br>MC_DIRECTION                           | For Direction selection 1 to 4 (Direction1 to Direction4), the directions of the structuring axes set for Interpolation axes 1 to 4 (InterpolationAxis1 to InterpolationAxis4) are set.<br>• 1: Positive direction (mcPositiveDirection)<br>• 2: Negative direction (mcNegativeDirection)<br>• 3: Shortest path (mcShortestWay)                                                                                                                                   |
| Direction3         | Direction selection 3<br>(+30)                  | INT<br>(MC_DIRECTION)<br>☞ Page 1520<br>MC_DIRECTION                           | The behavior will be as follows according to this setting.<br>• An interpolation axis where the software stroke limit is valid ignores the setting.                                                                                                                                                                                                                                                                                                               |
| Direction4         | Direction selection 4<br>(+31)                  | INT<br>(MC_DIRECTION)<br>☞ Page 1520<br>MC_DIRECTION                           | • "0" or the array elements of Direction selection 1 to 4 (Direction1 to Direction4) corresponding to omitted interpolation axes 1 to 4 (InterpolationAxis1 to InterpolationAxis4) can be omitted.                                                                                                                                                                                                                                                                |
| CircAuxPoint1      | Sub point 1<br>(+32)                            | LREAL                                                                          | The position of the sub point (border point, center point, or radius) used to perform circular interpolation control is set.                                                                                                                                                                                                                                                                                                                                      |
| CircAuxPoint2      | Sub point 2<br>(+36)                            | LREAL                                                                          | The setting range is as follows according to the Circular interpolation mode (CircMode) setting.<br>■When "0: Border point specification (mcBorder)" or "1: Center point specification (mcCenter)" is set                                                                                                                                                                                                                                                         |
| CircAuxPoint3      | Sub point 3<br>(+40)                            | LREAL                                                                          | The following is applied according to Control method (ControlMethod).<br>• "0103H: Absolute Value Circular Interpolation (CircularAbsolute)": -10000000000.0 ≤ Setting value < 10000000000.0                                                                                                                                                                                                                                                                      |
| CircAuxPoint4      | Sub point 4<br>(+44)                            | LREAL                                                                          | When the ring counter is enabled, the ring counter range is used.<br>• "0104H: Relative Value Circular Interpolation (CircularRelative)": -10000000000.0 to 10000000000.0<br>■When "2: Radius specification (mcRadius)" is set<br>• 0.000001 to 2147483647.0                                                                                                                                                                                                      |
| VelocityMode       | Speed mode<br>(+48)                             | INT<br>(MC_INTERPOLATE_SPEED_MODE)<br>☞ Page 1522<br>MC_INTERPOLATE_SPEED_MODE | The speed mode for linear interpolation control is set.<br>• 0: Vector speed (VectorSpeed)<br>• 1: Long axis speed (LongAxisSpeed)<br>• 2: Reference axis speed (ReferenceAxisSpeed)                                                                                                                                                                                                                                                                              |
| Reserve2 [0..2]    | Reserve 2<br>(+49)                              | WORD (UINT)                                                                    | Not used (For offset adjustment)                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Velocity           | Velocity<br>(+52)                               | LREAL                                                                          | The positioning speed of multiple axes interpolation.<br>• 0.0000, 0.0001 to 2500000000.0                                                                                                                                                                                                                                                                                                                                                                         |
| Acceleration       | Acceleration<br>(+56)                           | LREAL                                                                          | The acceleration of multiple axes interpolation.<br>The setting range is as follows according to the acceleration/deceleration method setting (bit 0 to 2) of Positioning data options (DataOptions).<br>■When "0: Acceleration/deceleration specification method (mcAccDec)" is set<br>• 0.0000, 0.0001 to 2147483647.0 [U/s <sup>2</sup> ]<br>■When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set<br>• 0.000000, 0.000001 to 8400.0 [s] |
| Deceleration       | Deceleration<br>(+60)                           | LREAL                                                                          | The deceleration of multiple axes interpolation.<br>■When "0: Acceleration/deceleration specification method (mcAccDec)" is set<br>• 0.0000, 0.0001 to 2147483647.0 [U/s <sup>2</sup> ]<br>■When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set<br>• Deceleration (Deceleration) is not used.                                                                                                                                              |
| Jerk               | Jerk<br>(+64)                                   | LREAL                                                                          | The jerk of multiple axes positioning control is set.<br>■When "0: Acceleration/deceleration specification method (mcAccDec)" is set<br>• 0.0000, 0.0001 to 2147483647.0 [U/s <sup>3</sup> ]<br>■When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set<br>• Jerk (Jerk) is not used.                                                                                                                                                         |
| CircErrorTolerance | Circular interpolation error tolerance<br>(+68) | LREAL                                                                          | The circular interpolation error tolerance is set for circular interpolation with the center specified.<br>• 0.000001 to 100000.0                                                                                                                                                                                                                                                                                                                                 |

| Variable name         | Name<br>(device offset)                              | Data type                                                                                                                                                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DataOptions           | Positioning data options<br>(+72)                    | DWORD (HEX)                                                                                                                                                            | <p>Options are set in the specified bit position.</p>  <p> <b>■Acceleration/deceleration method setting (bit 0 to 2)</b> <ul style="list-style-type: none"> <li>• 0: Acceleration/deceleration specification method (mcAccDec)</li> <li>• 1: Acceleration/deceleration time-fixed method (mcFixedTime)</li> </ul> <b>■Position selection during buffer mode (Bit 3)</b> <p>This option is set when "0102H: Relative Value Linear Interpolation (LinearRelative)" or "0104H: Relative Value Circular Interpolation (CircularRelative)" is set for Control method (ControlMethod).</p> <ul style="list-style-type: none"> <li>• 0: Set position</li> <li>• 1: Actual position</li> </ul> <p>Set "0" when "0101H: Absolute Value Linear Interpolation (LinearAbsolute)" or "0103H: Absolute Value Circular Interpolation (CircularAbsolute)" is set.</p> <b>■Target position specification exceeding the ring counter (bit 16)</b> <p>This option is set when "0101H: Absolute Value Linear Interpolation (LinearAbsolute)" is set for Control method (ControlMethod).</p> <ul style="list-style-type: none"> <li>• 0: Disabled</li> <li>• 1: Enabled</li> </ul> <p>Set "0" when "0102H: Relative Value Linear Interpolation (LinearRelative)", "0103H: Absolute Value Circular Interpolation (CircularAbsolute)", or "0104H: Relative Value Circular Interpolation (CircularRelative)" is set.</p> </p> |
| Reserve3 [0..1]       | Reserve 3<br>(+74)                                   | WORD (UINT)                                                                                                                                                            | Not used (For offset adjustment)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| DwellTime             | Dwell time<br>(+76)                                  | LREAL                                                                                                                                                                  | <p>The dwell time is set.</p> <ul style="list-style-type: none"> <li>• 0.0[s]: Dwell function disabled</li> <li>• 0.000001 to 8400.0[s]: Dwell function enabled</li> </ul> <p>When a positive number less than 0.000001 is set, the value is imported as "0.0[s]".</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Mcode                 | M code<br>(+80)                                      | WORD (UINT)                                                                                                                                                            | <p>The M code is set for each positioning data.</p> <p>When the M code is not output, set "0" (initial value).</p> <ul style="list-style-type: none"> <li>• 1 to 65535</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| McodeOutput_Override  | M code output timing<br>override<br>(+81)            | INT<br>(MC_MCODE_OUT<br>PUT_OVERRIDE)<br> Page 1525<br>MC_MCODE_OUT<br>PUT_OVERRIDE | <p>The M code output timing is set for each positioning data.</p> <ul style="list-style-type: none"> <li>• 0: Use FB Options (UseFbOptions)</li> <li>• 1: WITH Mode (WithMode)</li> <li>• 2: AFTER Mode (AfterMode)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| JumpDestinationDataNo | Jump destination<br>positioning data number<br>(+82) | WORD (UINT)                                                                                                                                                            | <p>The positioning data number is set for the jump destination specified with JUMP.</p> <p>Positioning data number (DataNo) is set for positioning data whose Control method (ControlMethod) is other than "0082H: JUMP (JUMP)".</p> <ul style="list-style-type: none"> <li>• 1 to total number of positioning data (5000)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ConditionSignalNo     | Condition signal number<br>(+83)                     | WORD (UINT)                                                                                                                                                            | <p>The condition signal number is set.</p> <p>When the condition signal is not used, set "0" (initial value).</p> <ul style="list-style-type: none"> <li>• 1 to 10</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| LoopCount             | Number of loops from<br>LOOP to LEND<br>(+84)        | WORD (UINT)                                                                                                                                                            | <p>The number of loop control repetitions is set.</p> <ul style="list-style-type: none"> <li>• 1 to 65535</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| SkipSignalNo          | Skip signal number<br>(+85)                          | WORD (UINT)                                                                                                                                                            | <p>The skip signal number is set.</p> <ul style="list-style-type: none"> <li>• 1 to 10</li> </ul> <p>When the skip signal is not used, set "0".</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Pitch                 | Pitch<br>(+86)                                       | WORD (UINT)                                                                                                                                                            | <p>The pitch is set.</p> <p>Set "0".</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Reserve4              | Reserve 4<br>(+87)                                   | WORD (UINT)                                                                                                                                                            | Not used (For offset adjustment)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## PROFILE\_POSITIONING\_DATA\_EXTENDED

| Variable name   | Name<br>(device offset)    | Data type    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------|----------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ConditionSignal | Condition signal<br>(+0)   | WSTRING (63) | <p>The condition signal is set as a TARGET_REF-type string. For details, refer to the following.</p> <p>📖 Page 1489 TARGET_REF (Input signal)</p> <p>The setting range of strings is as follows.*1</p> <p>■Data classification</p> <ul style="list-style-type: none"> <li>• [VAR]</li> <li>• [DEV]</li> </ul> <p>■Type</p> <ul style="list-style-type: none"> <li>• PROFILE_SIGNAL_SELECT_ELEMENT (📖 Page 1503 PROFILE_SIGNAL_SELECT_ELEMENT)</li> </ul> <p>When "" (no setting) is set, reading/writing is not performed.</p>                              |
| SkipSignal      | Skip signal<br>(+64)       | WSTRING (63) | <p>The skip signal is set as a TARGET_REF-type string. For details, refer to the following.</p> <p>📖 Page 1489 TARGET_REF (Input signal)</p> <p>The setting range of strings is as follows.*1</p> <p>■Data classification</p> <ul style="list-style-type: none"> <li>• [VAR]</li> <li>• [DEV]</li> </ul> <p>■Type</p> <ul style="list-style-type: none"> <li>• PROFILE_SIGNAL_SELECT_ELEMENT (📖 Page 1503 PROFILE_SIGNAL_SELECT_ELEMENT)</li> </ul> <p>When "" (no setting) is set, reading/writing is not performed.</p>                                   |
| PositioningData | Positioning data<br>(+128) | WSTRING (63) | <p>The positioning data is set as a TARGET_REF-type string. For details, refer to the following.</p> <p>📖 Page 1489 TARGET_REF (Input signal)</p> <p>The setting range of strings is as follows.</p> <p>■Data classification</p> <ul style="list-style-type: none"> <li>• [VAR]</li> <li>• [DEV]</li> </ul> <p>■Type</p> <ul style="list-style-type: none"> <li>• PROFILE_POSITIONING_DATA_ELEMENT (📖 Page 1498 PROFILE_POSITIONING_DATA_ELEMENT)</li> </ul> <p>When "" (no setting) is set, Read/Write data type incorrect (error code: 1BAAH) occurs.</p> |

\*1 If the specified type does not satisfy the requirements of individual structure members, Read/Write data type incorrect (error code: 1BAAH) occurs. Also, if the specified data type does not satisfy the requirements of individual structure members, Read/Write data data type incorrect (error code: 1BA8H) occurs.



## PROFILE\_SIGNAL\_SELECT\_ELEMENT

| Variable name    | Name<br>(device offset)          | Data type                                                                                                                                          | Description <sup>*1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| StartIO          | I/O number<br>(+0)               | WORD (HEX)                                                                                                                                         | Not used<br>The setting is ignored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Reserve1         | Reserve 1<br>(+1)                | WORD (UINT)                                                                                                                                        | Not used (For offset adjustment)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Target           | Target<br>(+2)                   | WSTRING (63)                                                                                                                                       | The signal to be used is set as a string. For details, refer to the following.<br> Page 1489 TARGET_REF (Input signal)<br>The setting range of strings is as follows.<br><ul style="list-style-type: none"> <li>• "" (string with a length of 0)<sup>*2</sup></li> </ul> ■Data classification<br><ul style="list-style-type: none"> <li>• [OBJ]<sup>*3</sup></li> <li>• [VAR]</li> <li>• [DEV]</li> </ul> ■Type<br><ul style="list-style-type: none"> <li>• BOOL</li> </ul> |
| Detection        | Signal detection method<br>(+66) | INT<br>(MC_SIGNAL_LOG<br>IC)<br> Page 1524<br>MC_SIGNAL_LOGI<br>C | The signal logic is specified.<br><ul style="list-style-type: none"> <li>• 0: Detection at TRUE (HighLevel)</li> <li>• 1: Detection at FALSE (LowLevel)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                           |
| Reserve2         | Reserve 2<br>(+67)               | WORD (UINT)                                                                                                                                        | Not used (For offset adjustment)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| CompensationTime | Compensation time<br>(+68)       | LREAL                                                                                                                                              | "0.0" is set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| FilterTime       | Filter time<br>(+72)             | LREAL                                                                                                                                              | The filter time for removing chattering of the I/O signal is set in units of seconds.<br><ul style="list-style-type: none"> <li>• 0.0 to 5.0[s]</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                   |

\*1 Errors due to setting values do not occur during writing. An error occurs if the setting is out of range when an operation profile data control FB uses a written open area.

\*2 If Target (Target) is a zero-length string (""), the applicable skip signal is handled without any setting.

\*3 If [OBJ] is set, the target modification cannot be omitted. If it is omitted, Operation profile data control profile ID setting incorrect warning (event code: 00D48H) occurs.

## SLAVE\_OBJECT\_REAL (for system)

Do not use this variable because it is for the system.

| Variable name                        | Name                                 | Data type   | Description                                                                                                         |
|--------------------------------------|--------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------|
| ControlWord                          | ControlWord                          | WSTRING(63) | Switching of the status is requested to the drive unit.                                                             |
| EncoderIncrements                    | EncoderIncrements                    | WSTRING(63) | The encoder resolution of the drive unit is acquired.                                                               |
| FollowingErrActualValue              | FollowingErrActualValue              | WSTRING(63) | The pulse droop of the drive unit                                                                                   |
| GearRatioMotorRevolutions            | GearRatioMotorRevolutions            | WSTRING(63) | The number of servo motor axis rotations (numerator) is set to the drive unit.                                      |
| HomeOffset                           | HomeOffset                           | WSTRING(63) | The difference between zero position and homing position of the machine coordinate system is set to the drive unit. |
| MaxMotorSpeed                        | MaxMotorSpeed                        | WSTRING(63) | The maximum speed of the servo motor is acquired from the drive unit.                                               |
| MaxTorque                            | MaxTorque                            | WSTRING(63) | The maximum torque of the servo motor is acquired from the drive unit.                                              |
| ModesOfOp                            | ModesOfOp                            | WSTRING(63) | Switching of the control mode is requested to the drive unit.                                                       |
| ModesOfOpDisp                        | ModesOfOpDisp                        | WSTRING(63) | Control mode of the drive unit is acquired.                                                                         |
| NegativeTorqueLimitValue             | NegativeTorqueLimitValue             | WSTRING(63) | The negative direction torque limit value is set to the drive unit.                                                 |
| Polarity                             | Polarity                             | WSTRING(63) | The rotation direction selection of drive unit is set.                                                              |
| PosActualValue                       | PosActualValue                       | WSTRING(63) | The current position of the drive unit                                                                              |
| PosEncoderResolution                 | PosEncoderResolution                 | WSTRING(63) | The total number of Sub Index (=2) is returned.                                                                     |
| PosEncoderResolutionMotorRevolutions | PosEncoderResolutionMotorRevolutions | WSTRING(63) | The number of rotations of the drive unit                                                                           |
| PositiveTorqueLimitValue             | PositiveTorqueLimitValue             | WSTRING(63) | The positive direction torque limit value is set to the drive unit.                                                 |
| ShaftRevolutions                     | ShaftRevolutions                     | WSTRING(63) | The number of drive axis rotations (denominator) of the drive unit is set.                                          |
| SiUnitPos                            | SiUnitPos                            | WSTRING(63) | The SI unit position of the drive unit is acquired.                                                                 |
| SiUnitVel                            | SiUnitVel                            | WSTRING(63) | The SI unit velocity of the drive unit is acquired.                                                                 |
| StatusWord                           | StatusWord                           | WSTRING(63) | The drive unit status is acquired.                                                                                  |
| SupportedDriveModes                  | SupportedDriveModes                  | WSTRING(63) | The control mode supported by the drive unit is acquired.                                                           |
| TargetPos                            | TargetPos                            | WSTRING(63) | The command position to be output to the drive unit                                                                 |
| TargetTorque                         | TargetTorque                         | WSTRING(63) | The command torque to be output to the drive unit                                                                   |
| TargetVelocity                       | TargetVelocity                       | WSTRING(63) | The command velocity to be output to the drive unit                                                                 |
| TargetActualValue                    | TorqueActualValue                    | WSTRING(63) | The current torque of the drive unit                                                                                |
| VelActualValue                       | VelActualValue                       | WSTRING(63) | The current speed of the drive unit                                                                                 |
| vControlDi1                          | ControlDi1                           | WSTRING(63) | The input device is set to the drive unit.                                                                          |
| vControlDi2                          | ControlDi2                           | WSTRING(63) | The input device is set to the drive unit.                                                                          |
| vControlDi3                          | ControlDi3                           | WSTRING(63) | The input device is set to the drive unit.                                                                          |
| vControlDi4                          | ControlDi4                           | WSTRING(63) | The input device is set to the drive unit.                                                                          |
| vControlDi5                          | ControlDi5                           | WSTRING(63) | The input device is set to the drive unit.                                                                          |
| vControlDi6                          | ControlDi6                           | WSTRING(63) | The input device is set to the drive unit.                                                                          |
| vControlDi7                          | ControlDi7                           | WSTRING(63) | The input device is set to the drive unit.                                                                          |
| vCurrentAlarm                        | CurrentAlarm                         | WSTRING(63) | The occurring alarm is acquired from the drive unit.                                                                |
| vEncoderStatus1                      | EncoderStatus1                       | WSTRING(63) | The encoder status is acquired from the drive unit.                                                                 |
| vHomeAbsCounter                      | HomeAbsCounter                       | WSTRING(63) | The encoder multiple revolution counter saved as the home position is acquired from the drive unit.                 |
| vHomeCycleCounter                    | HomeCycleCounter                     | WSTRING(63) | The encoder position within one revolution at power-on is acquired from the drive unit.                             |
| vInitialAbsCounter                   | InitialAbsCounter                    | WSTRING(63) | The encoder multiple revolution counter at power-on is acquired from the drive unit.                                |
| vInitialCycleCounter                 | InitialCycleCounter                  | WSTRING(63) | The encoder position within one revolution at power-on is acquired from the drive unit.                             |
| vInitialPos                          | InitialPos                           | WSTRING(63) | The current position at power-on is acquired from the drive unit.                                                   |
| vMaxAbsCounter                       | MaxAbsCounter                        | WSTRING(63) | The maximum value of the encoder multiple revolution counter is acquired from the drive unit.                       |
| vStatusDo1                           | StatusDo1                            | WSTRING(63) | The output device status of the drive unit is acquired.                                                             |

| Variable name                           | Name                                   | Data type   | Description                                                                                          |
|-----------------------------------------|----------------------------------------|-------------|------------------------------------------------------------------------------------------------------|
| vStatusDo2                              | StatusDo2                              | WSTRING(63) | The output device status of the drive unit is acquired.                                              |
| vStatusDo3                              | StatusDo3                              | WSTRING(63) | The output device status of the drive unit is acquired.                                              |
| vStatusDo4                              | StatusDo4                              | WSTRING(63) | The output device status of the drive unit is acquired.                                              |
| vStatusDo5                              | StatusDo5                              | WSTRING(63) | The output device status of the drive unit is acquired.                                              |
| vStatusDo6                              | StatusDo6                              | WSTRING(63) | The output device status of the drive unit is acquired.                                              |
| vStatusDo7                              | StatusDo7                              | WSTRING(63) | The output device status of the drive unit is acquired.                                              |
| vSupportedControlDi1                    | SupportedControlDi1                    | WSTRING(63) | The input device supported by the drive unit is acquired.                                            |
| vSupportedControlDi2                    | SupportedControlDi2                    | WSTRING(63) | The input device supported by the drive unit is acquired.                                            |
| vSupportedControlDi3                    | SupportedControlDi3                    | WSTRING(63) | The input device supported by the drive unit is acquired.                                            |
| vSupportedControlDi4                    | SupportedControlDi4                    | WSTRING(63) | The input device supported by the drive unit is acquired.                                            |
| vSupportedControlDi5                    | SupportedControlDi5                    | WSTRING(63) | The input device supported by the drive unit is acquired.                                            |
| vSupportedControlDi6                    | SupportedControlDi6                    | WSTRING(63) | The input device supported by the drive unit is acquired.                                            |
| vSupportedControlDi7                    | SupportedControlDi7                    | WSTRING(63) | The input device supported by the drive unit is acquired.                                            |
| vSupportedStatusDo1                     | SupportedStatusDo1                     | WSTRING(63) | The output device supported by the drive unit is acquired.                                           |
| vSupportedStatusDo2                     | SupportedStatusDo2                     | WSTRING(63) | The output device supported by the drive unit is acquired.                                           |
| vSupportedStatusDo3                     | SupportedStatusDo3                     | WSTRING(63) | The output device supported by the drive unit is acquired.                                           |
| vSupportedStatusDo4                     | SupportedStatusDo4                     | WSTRING(63) | The output device supported by the drive unit is acquired.                                           |
| vSupportedStatusDo5                     | SupportedStatusDo5                     | WSTRING(63) | The output device supported by the drive unit is acquired.                                           |
| vSupportedStatusDo6                     | SupportedStatusDo6                     | WSTRING(63) | The output device supported by the drive unit is acquired.                                           |
| vSupportedStatusDo7                     | SupportedStatusDo7                     | WSTRING(63) | The output device supported by the drive unit is acquired.                                           |
| vSyncAbsCounter                         | SyncAbsCounter                         | WSTRING(63) | The multiple revolution counter of the scale measurement encoder is acquired from the drive unit.    |
| vSyncCycleCounter                       | SyncCycleCounter                       | WSTRING(63) | The position within one revolution of the scale measurement encoder is acquired from the drive unit. |
| vVelLimitValue                          | VelLimitValue                          | WSTRING(63) | The velocity limit value is set to the drive unit.                                                   |
| vWatchDogCounterDI                      | WatchDogCounterDI                      | WSTRING(63) | The watchdog counter value is notified to the drive unit.                                            |
| vWatchDogCounterUI                      | WatchDogCounterUI                      | WSTRING(63) | The watchdog counter value is acquired in the drive unit.                                            |
| vEncoderStatus2                         | EncoderStatus2                         | WSTRING(63) | The scale measurement encoder status is acquired from the drive unit.                                |
| vScaleCycleCounter                      | ScaleCycleCounter                      | WSTRING(63) | The position within one revolution of the scale measurement encoder is acquired from the drive unit. |
| vScaleAbsCounter                        | ScaleAbsCounter                        | WSTRING(63) | The multiple revolution counter of the scale measurement encoder is acquired from the drive unit.    |
| vScaleMeasurementEncoderResolution      | ScaleMeasurementEncoderResolution      | WSTRING(63) | The scale measurement encoder resolution is acquired from the drive unit.                            |
| vScaleMeasurementEncoderReceptionStatus | ScaleMeasurementEncoderReceptionStatus | WSTRING(63) | The encoder position within one revolution is acquired from the drive unit.                          |

## SLAVE\_OBJECT\_ENCODER

| Variable name  | Name           | Data type   | Description                                                                                                                          |
|----------------|----------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------|
| PosActualValue | PosActualValue | WSTRING(63) | The data storing the synchronous encoder input is set.<br>When the I/O device is connected, imports the value from the set location. |

## SLAVE\_OBJECT\_VIRTUAL\_ENCODER

| Variable name  | Name           | Data type   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------|----------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PosActualValue | PosActualValue | WSTRING(63) | <p>The data used as the encoder input value is set in the string format.<br/>[VAR], [DEV], and [CONST] can be specified for the type.</p> <p>■ When [VAR] is set</p> <ul style="list-style-type: none"> <li>• Sets data of the (INT), (DINT), (WORD), and (DWORD) data types.</li> <li>• When [VAR] is used, local labels cannot be set.</li> </ul> <p>■ When [DEV] or [CONST] is set</p> <ul style="list-style-type: none"> <li>• Sets data of the (INT), (DINT), (WORD), and (DWORD) data types.</li> </ul> <p>* When this setting is omitted, Encoder input value (<u>AxisName</u>.Cd.Encoder_InputValue) is used.</p> |

## Other structure variable (Advanced synchronous control)

44

### ADV\_GEAR\_PARAM (Gear parameter)

| Variable name       | Name                            | Import                           | Data type     | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------|---------------------------------|----------------------------------|---------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MasterCompositeGear | Master axis composite gear      | Operation cycle (FB is starting) | WORD (HEX)    | LIST_WRITE<br>_BACK | The method of combining the current positions of the master axis and sub input axis is set.<br><ul style="list-style-type: none"> <li>• 0000H: No master axis input/no sub input axis input</li> <li>• 0001H: Positive master axis input and no sub-input axis input</li> <li>• 0002H: Negative master axis input and no sub-input axis input</li> <li>• 0010H: No master axis input and positive sub-input axis input</li> <li>• 0011H: Positive master axis input and positive sub-input axis input</li> <li>• 0012H: Negative master axis input and positive sub-input axis input</li> <li>• 0020H: No master axis input and negative sub-input axis input</li> <li>• 0021H: Positive master axis input and negative sub-input axis input</li> <li>• 0022H: Negative master axis input and negative sub-input axis input</li> </ul>                                                                   |
| MasterNumerator     | Master axis gear numerator      | At start                         | DINT          | LIST_WRITE<br>_BACK | The master axis gear numerator is set.<br><ul style="list-style-type: none"> <li>• -2147483647 to 2147483647</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| MasterDenominator   | Master axis gear denominator    | At start                         | DWORD (UDINT) | LIST_WRITE<br>_BACK | The master axis gear denominator is set.<br><ul style="list-style-type: none"> <li>• 1 to 2147483647</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| AuxCompositeGear    | Auxiliary axis composite gear   | Operation cycle (FB is starting) | WORD (HEX)    | LIST_WRITE<br>_BACK | The method of combining the current position after the master axis and sub input axis are combined and the current position of the auxiliary axis is set.<br><ul style="list-style-type: none"> <li>• 0000H: No master axis input and no auxiliary axis input</li> <li>• 0001H: Positive master axis input and no auxiliary axis input</li> <li>• 0002H: Negative master axis input and no auxiliary axis input</li> <li>• 0010H: No master axis input and positive auxiliary axis input</li> <li>• 0011H: Positive master axis input and positive auxiliary axis input</li> <li>• 0012H: Negative master axis input and positive auxiliary axis input</li> <li>• 0020H: No master axis input and negative auxiliary axis input</li> <li>• 0021H: Positive master axis input and negative auxiliary axis input</li> <li>• 0022H: Negative master axis input and negative auxiliary axis input</li> </ul> |
| AuxNumerator        | Auxiliary axis gear numerator   | At start                         | DINT          | LIST_WRITE<br>_BACK | The auxiliary axis gear numerator is set.<br><ul style="list-style-type: none"> <li>• -2147483647 to 2147483647</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| AuxDenominator      | Auxiliary axis gear denominator | At start                         | DWORD (UDINT) | LIST_WRITE<br>_BACK | The auxiliary axis gear denominator is set.<br><ul style="list-style-type: none"> <li>• 1 to 2147483647</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## ADV\_CLUTCH\_PARAM (Clutch parameter)

| Variable name                | Name                                         | Import                              | Data type                                                                                                                                            | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------|----------------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MasterOnControl              | Master axis ON clutch control setting        | Operation cycle (FB is starting)    | INT<br>(MC_CLUTCH_METHOD)<br> Page 1526<br>MC_CLUTCH_METHOD         | LIST_WRITE<br>_BACK | The ON control method for the master axis clutch is set.<br><ul style="list-style-type: none"> <li>• 0: Invalid (NoClutch) (Direct operation)</li> <li>• 1: Clutch command (ClutchCommand)</li> <li>• 2: Clutch command rising edge (ClutchLeadingEdge)</li> <li>• 3: Clutch command falling edge (ClutchTrailingEdge)</li> <li>• 4: Address mode (ClutchAddress)</li> <li>• 15: I/O data specification (ClutchSignal)</li> </ul> *: The value can be changed during synchronization control. However, it cannot be changed from the setting other than "0: Invalid (NoClutch)" to "0: Invalid (NoClutch)". |
| MasterOffControl             | Master axis OFF clutch control setting       | Operation cycle (FB is starting)    | INT<br>(MC_CLUTCH_METHOD)<br> Page 1526<br>MC_CLUTCH_METHOD         | LIST_WRITE<br>_BACK | The OFF control method for the master axis clutch is set.<br><ul style="list-style-type: none"> <li>• 0: Invalid (NoClutch) (OFF control invalid)</li> <li>• 1: Clutch command (ClutchCommand) (One-shot operation)</li> <li>• 2: Clutch command rising edge (ClutchLeadingEdge)</li> <li>• 3: Clutch command falling edge (ClutchTrailingEdge)</li> <li>• 4: Address mode (ClutchAddress)</li> <li>• 15: I/O data specification (ClutchSignal)</li> </ul>                                                                                                                                                  |
| MasterReference              | Master axis clutch reference address setting | At start                            | INT<br>(MC_CLUTCH_REFERENCE)<br> Page 1526<br>MC_CLUTCH_REFERENCE | LIST_WRITE<br>_BACK | The address to be referenced during master axis clutch control is set.<br><ul style="list-style-type: none"> <li>• 0: Current position before gear (GearFrontPosition)</li> <li>• 1: Current position per cycle after gear (GearPositionPerCycle)</li> </ul> *: Note that the reference address changes the processing order of gears and clutches.                                                                                                                                                                                                                                                         |
| MasterOnAddress              | Master axis clutch ON address                | Operation cycle (FB is starting)    | LREAL                                                                                                                                                | LIST_WRITE<br>_BACK | The address for turning on the clutch is set when Master axis ON clutch control setting ( <u>AdvOutputName.Pr.Clutch.MasterOnControl</u> ) is set to "4: Address mode (ClutchAddress)".<br>When Master axis clutch reference address setting ( <u>AdvOutputName.Pr.Clutch.MasterReference</u> ) is set to "1: Current position per cycle after gear (GearPositionPerCycle)", the set value is converted for control within the range from 0.0 to (Length per cycle - 0.00001).<br>• -10000000000.0 to 10000000000.0                                                                                         |
| MasterMovementAmountBeforeOn | Movement amount before master axis clutch ON | When the clutch ON condition is met | LREAL                                                                                                                                                | LIST_WRITE<br>_BACK | A signed value for the movement amount of the reference address, from the point when the ON condition is met in the master axis clutch ON control to when the clutch is actually turned on, is set.<br>• -2147483648.0 to 2147483647.0                                                                                                                                                                                                                                                                                                                                                                      |

| Variable name                 | Name                                               | Import                                             | Data type                                                                                                                                                        | Attribute       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------|----------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MasterOffAddress              | Master axis clutch OFF address                     | Operation cycle (FB is starting)                   | LREAL                                                                                                                                                            | LIST_WRITE_BACK | The address for turning off the clutch is set when Master axis OFF clutch control setting ( <u>AdvOutputName.Pr.Clutch.MasterOffControl</u> ) is set to "4: Address mode (ClutchAddress)".<br>When Master axis clutch reference address setting ( <u>AdvOutputName.Pr.Clutch.MasterReference</u> ) is set to "1: Current position per cycle after gear (GearPositionPerCycle)", the set value is converted for control within the range from 0.0 to (Length per cycle - 0.00001).<br>• -10000000000.0 to 10000000000.0                                                                                                       |
| MasterMovementAmountBeforeOff | Master axis clutch OFF preliminary movement amount | When the clutch OFF condition is met <sup>*1</sup> | LREAL                                                                                                                                                            | LIST_WRITE_BACK | A signed value for the movement amount of the reference address, from the point when the OFF condition is met in the master axis clutch OFF control to when the clutch is actually turned off, is set.<br>• -2147483648.0 to 2147483647.0                                                                                                                                                                                                                                                                                                                                                                                    |
| MasterSmoothingMethod         | Master axis clutch smoothing method                | At start                                           | INT<br>(MC_CLUTCH_SMOOTHING_METHOD)<br> Page 1526<br>MC_CLUTCH_SMOOTHING_METHOD | LIST_WRITE_BACK | The smoothing method for the time when the master axis clutch is set to on/off is set.<br>• 0: Direct (ClutchSmoothingDisabled)<br>• 1: Time constant method (exponent) (TimeConstantExponent)<br>• 2: Time constant method (linear) (TimeConstantLinear)<br>• 3: Slippage amount method (exponent) (SlippageExponent)<br>• 4: Slippage amount method (linear) (SlippageLinear)<br>• 5: Slippage amount method (linear: input amount follow-up) (SlippageLinearFollow)                                                                                                                                                       |
| MasterOnSlippageAmount        | Master axis clutch ON slippage amount              | At clutch ON start                                 | LREAL                                                                                                                                                            | LIST_WRITE_BACK | The slippage amount at which the clutch turned on is set when Master axis clutch smoothing method ( <u>AdvOutputName.Pr.Clutch.MasterSmoothingMethod</u> ) is set to "3: Slippage amount method (exponent) (SlippageExponent)", "4: Slippage amount method (linear) (SlippageLinear)", or "5: Slippage amount method (linear: input amount follow-up) (SlippageLinearFollow)".<br>• 0.0 to 2147483647.0<br>*: When the setting value is negative, the control is applied on the assumption that Master axis clutch ON slippage amount ( <u>AdvOutputName.Pr.Clutch.MasterOnSlippageAmount</u> ) is set to "0.0 (Direct)".    |
| MasterOffSlippageAmount       | Master axis clutch OFF slippage amount             | At clutch OFF start                                | LREAL                                                                                                                                                            | LIST_WRITE_BACK | The slippage amount at which the clutch turned off is set when Master axis clutch smoothing method ( <u>AdvOutputName.Pr.Clutch.MasterSmoothingMethod</u> ) is set to "3: Slippage amount method (exponent) (SlippageExponent)", "4: Slippage amount method (linear) (SlippageLinear)", or "5: Slippage amount method (linear: input amount follow-up) (SlippageLinearFollow)".<br>• 0.0 to 2147483647.0<br>*: When the setting value is negative, the control is applied on the assumption that Master axis clutch OFF slippage amount ( <u>AdvOutputName.Pr.Clutch.MasterOffSlippageAmount</u> ) is set to "0.0 (Direct)". |

| Variable name              | Name                                            | Import                              | Data type                                                                                                                                          | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------|-------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AuxOnControl               | Auxiliary axis ON clutch control setting        | Operation cycle (FB is starting)    | INT<br>(MC_CLUTCH_METHOD)<br> Page 1526<br>MC_CLUTCH_METHOD       | LIST_WRITE<br>_BACK | The ON control method for the auxiliary axis clutch is set.<br><ul style="list-style-type: none"> <li>• 0: Invalid (NoClutch) (Direct operation)</li> <li>• 1: Clutch command (ClutchCommand)</li> <li>• 2: Clutch command rising edge (ClutchLeadingEdge)</li> <li>• 3: Clutch command falling edge (ClutchTrailingEdge)</li> <li>• 4: Address mode (ClutchAddress)</li> <li>• 15: I/O data specification (ClutchSignal)</li> </ul> *: The value can be changed during synchronization control. However, it cannot be changed from the setting other than "0: Invalid (NoClutch) (Direct operation)" to "0: Invalid (NoClutch) (Direct operation)". |
| AuxOffControl              | Auxiliary axis OFF clutch control setting       | Operation cycle (FB is starting)    | INT<br>(MC_CLUTCH_METHOD)<br> Page 1526<br>MC_CLUTCH_METHOD       | LIST_WRITE<br>_BACK | The OFF control method for the auxiliary axis clutch is set.<br><ul style="list-style-type: none"> <li>• 0: Invalid (NoClutch) (OFF control invalid)</li> <li>• 1: Clutch command (ClutchCommand) (One-shot operation)</li> <li>• 2: Clutch command rising edge (ClutchLeadingEdge)</li> <li>• 3: Clutch command falling edge (ClutchTrailingEdge)</li> <li>• 4: Address mode (ClutchAddress)</li> <li>• 15: I/O data specification (ClutchSignal)</li> </ul>                                                                                                                                                                                        |
| AuxReference               | Auxiliary axis clutch reference address setting | At start                            | INT<br>(MC_CLUTCH_REFERENCE)<br> Page 1526<br>MC_CLUTCH_REFERENCE | LIST_WRITE<br>_BACK | The address to be referenced during auxiliary axis clutch control is set.<br><ul style="list-style-type: none"> <li>• 0: Current position before gear (GearFrontPosition)</li> <li>• 1: Current position per cycle after gear (GearPositionPerCycle)</li> </ul> *: Note that the reference address changes the processing order of gears and clutches.                                                                                                                                                                                                                                                                                               |
| AuxOnAddress               | Auxiliary axis clutch ON address                | Operation cycle (FB is starting)    | LREAL                                                                                                                                              | LIST_WRITE<br>_BACK | The address for turning on the clutch is set when Auxiliary axis ON clutch control setting ( <u>AdvOutputName.Pr.Clutch.AuxOnControl</u> ) is set to "4: Address mode (ClutchAddress)".<br>When Auxiliary axis clutch reference address setting ( <u>AdvOutputName.Pr.Clutch.AuxReference</u> ) is set to "1: Current position per cycle after gear (GearPositionPerCycle)", the set value is converted for control within the range from 0.0 to (Length per cycle - 0.00001).<br><ul style="list-style-type: none"> <li>• -10000000000.0 to 10000000000.0</li> </ul>                                                                                |
| AuxMovementAmountBefore On | Movement amount before auxiliary axis clutch ON | When the clutch ON condition is met | LREAL                                                                                                                                              | LIST_WRITE<br>_BACK | A signed value for the movement amount of the reference address, from the point when the ON condition is met in the auxiliary axis clutch ON control to when the clutch is actually turned on, is set.<br><ul style="list-style-type: none"> <li>• -2147483648.0 to 2147483647.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                          |



| Variable name               | Name                                             | Import                                             | Data type                                                                                                                                                        | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------|--------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AuxOffAddress               | Auxiliary axis clutch OFF address                | Operation cycle (FB is starting)                   | LREAL                                                                                                                                                            | LIST_WRITE<br>_BACK | The address for turning off the clutch is set when Auxiliary axis OFF clutch control setting ( <u>AdvOutputName.Pr.Clutch.AuxOffControl</u> ) is set to "4: Address mode (ClutchAddress)".<br>When Auxiliary axis clutch reference address setting ( <u>AdvOutputName.Pr.Clutch.AuxReference</u> ) is set to "1: Current position per cycle after gear (GearPositionPerCycle)", the set value is converted for control within the range from 0.0 to (Length per cycle - 0.00001).<br>• -10000000000.0 to 10000000000.0                                                                                                       |
| AuxMovementAmountBefore Off | Movement amount before auxiliary axis clutch OFF | When the clutch OFF condition is met* <sup>1</sup> | LREAL                                                                                                                                                            | LIST_WRITE<br>_BACK | A signed value for the movement amount of the reference address, from the point when the OFF condition is met in the auxiliary axis clutch OFF control to when the clutch is actually turned off, is set.<br>• -2147483648.0 to 2147483647.0                                                                                                                                                                                                                                                                                                                                                                                 |
| AuxSmoothingMethod          | Auxiliary axis clutch smoothing method           | At start                                           | INT<br>(MC_CLUTCH_SMOOTHING_METHOD)<br> Page 1526<br>MC_CLUTCH_SMOOTHING_METHOD | LIST_WRITE<br>_BACK | The smoothing method for when the auxiliary axis clutch is set to on/off.<br>• 0: Direct (ClutchSmoothingDisabled)<br>• 1: Time constant method (exponent) (TimeConstantExponent)<br>• 2: Time constant method (linear) (TimeConstantLinear)<br>• 3: Slippage amount method (exponent) (SlippageExponent)<br>• 4: Slippage amount method (linear) (SlippageLinear)<br>• 5: Slippage amount method (linear: input amount follow-up) (SlippageLinearFollow)                                                                                                                                                                    |
| AuxOnSlippageAmount         | Auxiliary axis clutch ON slippage amount         | At clutch ON start                                 | LREAL                                                                                                                                                            | LIST_WRITE<br>_BACK | The slippage amount at which the clutch turned on is set when Auxiliary axis clutch smoothing method ( <u>AdvOutputName.Pr.Clutch.AuxSmoothingMethod</u> ) is set to "3: Slippage amount method (exponent) (SlippageExponent)", "4: Slippage amount method (linear) (SlippageLinear)", or "5: Slippage amount method (linear: input amount follow-up) (SlippageLinearFollow)".<br>• 0.0 to 2147483647.0<br>*: When the setting value is negative, the control is applied on the assumption that Auxiliary axis clutch ON slippage amount ( <u>AdvOutputName.Pr.Clutch.AuxOnSlippageAmount</u> ) is set to "0.0 (Direct)".    |
| AuxOffSlippageAmount        | Auxiliary axis clutch OFF slippage amount        | At clutch OFF start                                | LREAL                                                                                                                                                            | LIST_WRITE<br>_BACK | The slippage amount at which the clutch turned off is set when Auxiliary axis clutch smoothing method ( <u>AdvOutputName.Pr.Clutch.AuxSmoothingMethod</u> ) is set to "3: Slippage amount method (exponent) (SlippageExponent)", "4: Slippage amount method (linear) (SlippageLinear)", or "5: Slippage amount method (linear: input amount follow-up) (SlippageLinearFollow)".<br>• 0.0 to 2147483647.0<br>*: When the setting value is negative, the control is applied on the assumption that Auxiliary axis clutch OFF slippage amount ( <u>AdvOutputName.Pr.Clutch.AuxOffSlippageAmount</u> ) is set to "0.0 (Direct)". |

\*1 For the one-shot operation, "when clutch on condition is met" applies.

## ADV\_CLUTCH\_MONI (Clutch monitor)

| Variable name            | Name                                             | Import                           | Data type | Attribute      | Description                                                                                                                       |
|--------------------------|--------------------------------------------------|----------------------------------|-----------|----------------|-----------------------------------------------------------------------------------------------------------------------------------|
| MasterOnOffStatus        | Master axis clutch ON/OFF status                 | Operation cycle (FB is starting) | BOOL      | LIST_READ_ONLY | The on/off status of the master axis clutch is stored.<br>• FALSE: Clutch OFF status<br>• TRUE: Clutch ON status                  |
| MasterSmoothingStatus    | Master axis clutch smoothing status              | Operation cycle (FB is starting) | BOOL      | LIST_READ_ONLY | The smoothing status of the master axis clutch is stored.<br>• FALSE: No clutch smoothing<br>• TRUE: Clutch smoothing in progress |
| MasterCumulativeSlippage | Master axis clutch cumulative slippage amount    | Operation cycle (FB is starting) | LREAL     | LIST_READ_ONLY | The cumulative slippage amount during clutch smoothing with a slippage method is stored with a signed value.                      |
| AuxOnOffStatus           | Auxiliary axis clutch ON/OFF status              | Operation cycle (FB is starting) | BOOL      | LIST_READ_ONLY | The on/off status of the auxiliary axis clutch is stored.<br>• FALSE: Clutch OFF status<br>• TRUE: Clutch ON status               |
| AuxSmoothingStatus       | Auxiliary axis clutch smoothing status           | Operation cycle (FB is starting) | BOOL      | LIST_READ_ONLY | The smoothing status of the auxiliary axis clutch is stored.<br>• FALSE: Not on clutch smoothing<br>• TRUE: On clutch smoothing   |
| AuxCumulativeSlippage    | Auxiliary axis clutch cumulative slippage amount | Operation cycle (FB is starting) | LREAL     | LIST_READ_ONLY | The cumulative slippage amount during clutch smoothing with a slippage method is stored with a signed value.                      |

## ADV\_CLUTCH\_CMD (Clutch control data)

| Variable name        | Name                                       | Import                           | Data type | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------|--------------------------------------------|----------------------------------|-----------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MasterCommand        | Master axis clutch command                 | Operation cycle (FB is starting) | BOOL      | LIST_READ_ONLY | Whether to turn on or off the master axis clutch command is set.<br>This variable is used when Master axis ON clutch control setting ( <u>AdvOutputName.Pr.Clutch.MasterOnControl</u> ) is set to "1: Clutch command (ClutchCommand)", "2: Clutch command rising edge (ClutchLeadingEdge)", or "3: Clutch command falling edge (ClutchTrailingEdge)".<br>• FALSE: The clutch command is turned off.<br>• TRUE: The clutch command is turned on.                                                                                                |
| MasterInvalidCommand | Master axis clutch control invalid command | Operation cycle (FB is starting) | BOOL      | LIST_READ_ONLY | The valid/invalid of master axis clutch control is switched.<br>The on/off status of the clutch remains the status before clutch control becomes invalid.<br>Clutch control does not become invalid during movement before clutch ON or before clutch OFF. Clutch control becomes invalid after movement before clutch ON or before clutch OFF.<br>• FALSE: Clutch control is valid.<br>• TRUE: Clutch control is invalid.                                                                                                                     |
| MasterForcedOff      | Master axis clutch forced off command      | Operation cycle (FB is starting) | BOOL      | LIST_READ_ONLY | The master axis clutch is forcibly turned off.<br>• FALSE: The clutch is controlled normally.<br>• TRUE: The clutch is forcibly turned off.<br>*: The output from the clutch immediately becomes "0" during the execution of clutch smoothing.<br>*: When the slippage amount method smoothing is performed, the cumulative slippage amount is cleared to 0.<br>*: When the setting value is changed to "FALSE" after the clutch is forcibly turned off, the normal clutch control restarts from the status in which the clutch is turned off. |
| AuxCommand           | Auxiliary axis clutch command              | Operation cycle (FB is starting) | BOOL      | LIST_READ_ONLY | Whether to turn on or off the auxiliary axis clutch command is set.<br>This variable is used when Auxiliary axis ON clutch control setting ( <u>AdvOutputName.Pr.Clutch.AuxOnControl</u> ) is set to "1: Clutch command (ClutchCommand)", "2: Clutch command rising edge (ClutchLeadingEdge)", or "3: Clutch command falling edge (ClutchTrailingEdge)".<br>• FALSE: The clutch command is turned off.<br>• TRUE: The clutch command is turned on.                                                                                             |

| Variable name                     | Name                                                       | Import                           | Data type | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------|------------------------------------------------------------|----------------------------------|-----------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AuxInvalidCommand                 | Auxiliary axis clutch control invalid command              | Operation cycle (FB is starting) | BOOL      | LIST_READ_ONLY | <p>The valid/invalid of auxiliary axis clutch control is switched. The on/off status of the clutch remains the status before clutch control becomes invalid. Clutch control does not become invalid during movement before clutch ON or before clutch OFF. Clutch control becomes invalid after movement before clutch ON or before clutch OFF.</p> <ul style="list-style-type: none"> <li>• FALSE: Clutch control is valid.</li> <li>• TRUE: Clutch control is invalid.</li> </ul>                                                                                                                                       |
| AuxForcedOff                      | Auxiliary axis clutch forced off command                   | Operation cycle (FB is starting) | BOOL      | LIST_READ_ONLY | <p>The auxiliary axis clutch is forcibly turned off.</p> <ul style="list-style-type: none"> <li>• FALSE: The clutch is controlled normally.</li> <li>• TRUE: The clutch is forcibly turned off.</li> </ul> <p>*: The output from the clutch immediately becomes "0" during the execution of clutch smoothing.</p> <p>*: When the slippage amount method smoothing is performed, the cumulative slippage amount is cleared to 0.</p> <p>*: When the setting value is changed to "FALSE" after the clutch is forcibly turned off, the normal clutch control restarts from the status in which the clutch is turned off.</p> |
| MasterClutchSmoothingTimeConstant | Master axis clutch smoothing time constant change value    | At start                         | INT       | LIST_READ_ONLY | <p>Master axis clutch smoothing time constant (<u>AdvOutPutName</u>.Cd.Clutch.MasterClutchSmoothingTimeConstant) is changed.</p> <ul style="list-style-type: none"> <li>• 0 to 5000 [ms]</li> </ul> <p>*: Smoothing is not performed if a negative value is set.</p> <p>*: When "0" is set, smoothing is performed with the setting value of Master axis clutch smoothing time constant (<u>AdvOutPutName</u>.PrConst.MasterClutchSmoothingTimeConstant).</p>                                                                                                                                                             |
| AuxClutchSmoothingTimeConstant    | Auxiliary axis clutch smoothing time constant change value | At start                         | INT       | LIST_READ_ONLY | <p>Auxiliary axis clutch smoothing time constant (<u>AdvOutPutName</u>.Cd.Clutch.AuxClutchSmoothingTimeConstant) is changed.</p> <ul style="list-style-type: none"> <li>• 0 to 5000 [ms]</li> </ul> <p>*: Smoothing is not performed if a negative value is set.</p> <p>*: When "0" is set, smoothing is performed with the setting value of Auxiliary axis clutch smoothing time constant (<u>AdvOutPutName</u>.PrConst.AuxClutchSmoothingTimeConstant).</p>                                                                                                                                                             |

## ADV\_SPEEDCHANGEGEAR\_PARAM (Speed change gear parameter)

| Variable name          | Name                                           | Import                           | Data type     | Attribute       | Description                                                                                                                                          |
|------------------------|------------------------------------------------|----------------------------------|---------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| MasterGearIn           | Master axis speed change gear valid setting    | At start                         | BOOL          | LIST_WRITE_BACK | Whether to use the master axis speed change gear is set.<br>• FALSE: The speed change gear is not used.<br>• TRUE: The speed change gear is used.    |
| MasterRatioNumerator   | Master axis speed change ratio numerator       | Operation cycle (FB is starting) | DINT          | LIST_WRITE_BACK | The master axis speed change ratio numerator is set.<br>• -2147483648 to 2147483647                                                                  |
| MasterRatioDenominator | Master axis speed change ratio denominator     | Operation cycle (FB is starting) | DWORD (UDINT) | LIST_WRITE_BACK | The master axis speed change ratio denominator is set.<br>• 1 to 2147483647                                                                          |
| AuxGearIn              | Auxiliary axis speed change gear valid setting | At start                         | BOOL          | LIST_WRITE_BACK | Whether to use the auxiliary axis speed change gear is set.<br>• FALSE: The speed change gear is not used.<br>• TRUE: The speed change gear is used. |
| AuxRatioNumerator      | Auxiliary axis speed change ratio numerator    | Operation cycle (FB is starting) | DINT          | LIST_WRITE_BACK | The auxiliary axis speed change ratio numerator is set.<br>• -2147483648 to 2147483647                                                               |
| AuxRatioDenominator    | Auxiliary axis speed change ratio denominator  | Operation cycle (FB is starting) | DWORD (UDINT) | LIST_WRITE_BACK | The auxiliary axis speed change ratio denominator is set.<br>• 1 to 2147483647                                                                       |
| OutGearIn              | Output axis speed change gear valid setting    | At start                         | BOOL          | LIST_WRITE_BACK | Whether to use the output axis speed change gear is set.<br>• FALSE: The speed change gear is not used.<br>• TRUE: The speed change gear is used.    |
| OutRatioNumerator      | Output axis speed change ratio numerator       | Operation cycle (FB is starting) | DINT          | LIST_WRITE_BACK | The output axis speed change ratio numerator is set.<br>• -2147483648 to 2147483647                                                                  |
| OutRatioDenominator    | Output axis speed change ratio denominator     | Operation cycle (FB is starting) | DWORD (UDINT) | LIST_WRITE_BACK | The output axis speed change ratio denominator is set.<br>• 1 to 2147483647                                                                          |

## ADV\_SPEEDCHANGEGEAR\_CMD (Speed change gear control data)

| Variable name               | Name                                                                  | Import   | Data type | Attribute       | Description                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------|-----------------------------------------------------------------------|----------|-----------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MasterSmoothingTimeConstant | Master axis speed change gear smoothing time constant change value    | At start | INT       | LIST_WRITE_BACK | The master axis speed change gear smoothing time constant is changed.<br>• 0 to 5000 [ms]<br>*: Smoothing is not performed if a negative value is set.<br>*: When "0" is set, smoothing is performed with the setting value of Master axis speed change gear smoothing time constant (AdvOutPutName.PrConst.MasterSpeedChangeGearSmoothingTimeConstant).    |
| AuxSmoothingTimeConstant    | Auxiliary axis speed change gear smoothing time constant change value | At start | INT       | LIST_WRITE_BACK | The auxiliary axis speed change gear smoothing time constant is changed.<br>• 0 to 5000 [ms]<br>*: Smoothing is not performed if a negative value is set.<br>*: When "0" is set, smoothing is performed with the setting value of Auxiliary axis speed change gear smoothing time constant (AdvOutPutName.PrConst.AuxSpeedChangeGearSmoothingTimeConstant). |
| OutSmoothingTimeConstant    | Output axis speed change gear smoothing time constant change value    | At start | INT       | LIST_WRITE_BACK | The output axis speed change gear smoothing time constant is changed.<br>• 0 to 5000 [ms]<br>*: Smoothing is not performed if a negative value is set.<br>*: When "0" is set, smoothing is performed with the setting value of Output axis speed change gear smoothing time constant (AdvOutPutName.PrConst.OutSpeedChangeGearSmoothingTimeConstant).       |

## ADV\_CAM\_PARAM (Cam parameter)

| Variable name                 | Name                                | Import                                            | Data type                                                                                                                                                       | Attribute       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------|-------------------------------------|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LengthPerCycle                | Length per cycle                    | At start/When the 0th point of cam data is passed | LREAL                                                                                                                                                           | LIST_WRITE_BACK | The length per cycle of the cam shaft for generating the current position per cycle is set. The unit is that of the input axis set in Master axis (Master) of MCv_AdvancedSync (Advanced synchronous control).<br>• 1.0 to 2147483647.0                                                                                                                                                                                                                                                                                                                                                                |
| StrokeAmount                  | Cam stroke amount                   | At start/When the 0th point of cam data is passed | LREAL                                                                                                                                                           | LIST_WRITE_BACK | The cam stroke amount corresponding to the stroke ratio at 100% is set by output axis position units when Interpolation method specification (Interpolate) of the operation profile data is set to "1: Specifying for each section" or "2: Spline interpolation", or when the data format type is set to "rotary cutter".<br>• -2147483648.0 to 2147483647.0                                                                                                                                                                                                                                           |
| CamNo                         | Cam number                          | At start/When the 0th point of cam data is passed | WORD (UINT)                                                                                                                                                     | LIST_WRITE_BACK | The cam number to be used for cam control is set.<br>• 0 to 60000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| StartingPoint                 | Cam start point                     | At start/When the 0th point of cam data is passed | DWORD (UDINT)                                                                                                                                                   | LIST_WRITE_BACK | The start position of cam data is set by the resolution.<br>This variable is valid only when Interpolation method specification (Interpolate) of the operation profile data is set to "1: Specifying for each section" or "2: Spline interpolation", or when the data format type is set to "rotary cutter".<br>The initial value of Cam start point ( <u>AdvOutputName.Pr.Cam.StrokeAmount</u> ) is "0". (The cam axis is controlled from the 0th point of cam data (stroke ratio 0%).) If a value other than "0" is set, the cam control starts from the stroke ratio other than 0%.<br>• 0 to 65535 |
| LengthPerCycleChange          | Length per cycle change setting     | At start                                          | INT (MC_LENGTH_PER_CYCLE_CHANGE)<br> Page 1526<br>MC_LENGTH_PER_CYCLE_CHANGE | LIST_WRITE_BACK | This variable is set when Length per cycle ( <u>AdvOutputName.Pr.Cam.LengthPerCycle</u> ) is to be changed during synchronous control.<br>• 0: Invalid (LengthChangeInvalid)<br>• 1: Valid (LengthChangeValid)                                                                                                                                                                                                                                                                                                                                                                                         |
| PhaseCompensationAdvancedTime | Phase compensation advancement time | At start/Operation cycle (FB is starting)         | DINT                                                                                                                                                            | LIST_WRITE_BACK | This variable is set to advance or delay the phase of the current position per cycle during cam control.<br>• -100000000 to 100000000 [μs]                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| PhaseCompensationTimeConstant | Phase compensation time constant    | At start                                          | WORD (UINT)                                                                                                                                                     | LIST_WRITE_BACK | The time constant at which the phase compensation amount during phase compensation is reflected with a primary delay is set.<br>63% of the phase compensation amount is reflected with the set time constant.<br>• 0 to 65535 [ms]                                                                                                                                                                                                                                                                                                                                                                     |

## ADV\_CAM\_MONI (Cam monitor)

| Variable name                  | Name                                                 | Import                           | Data type     | Attribute      | Description                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------|------------------------------------------------------|----------------------------------|---------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PhaseCompensationAmount        | Phase compensation amount                            | Operation cycle (FB is starting) | LREAL         | LIST_READ_ONLY | The cam axis phase compensation amount is stored in the unit that of the input axis set in Master axis (Master) of MCv_AdvancedSync (Advanced synchronous control).<br>The phase compensation amount after smoothing processing with Phase compensation time constant ( <u>AdvOutputName</u> .Pr.Cam.PhaseCompensationTimeConstant) is stored.                                                                                  |
| MasterCompositeGearSetPosition | Current position after master axis composite gear    | Operation cycle (FB is starting) | LREAL         | LIST_READ_ONLY | The cumulative value that indicates the current position after the master axis and sub-input axis are combined using the master axis composite gear is stored.<br>The value in the unit that of the input axis set as Master axis (Master) of MCv_AdvancedSync (Advanced synchronous control) is stored.                                                                                                                        |
| MasterGearPositionPerCycle     | Current position per cycle after master axis gear    | Operation cycle (FB is starting) | LREAL         | LIST_READ_ONLY | The input movement amount after the master axis gear is stored in the range from 0.0 to (Length per cycle - 0.00001).<br>The unit is that of the input axis set in Master axis (Master) of MCv_AdvancedSync (Advanced synchronous control).                                                                                                                                                                                     |
| AuxGearPositionPerCycle        | Current position per cycle after auxiliary axis gear | Operation cycle (FB is starting) | LREAL         | LIST_READ_ONLY | The input movement amount after the auxiliary axis gear is stored in the range from 0.0 to (Length per cycle - 0.00001).<br>The unit is that of the input axis set in Master axis (Master) of MCv_AdvancedSync (Advanced synchronous control).                                                                                                                                                                                  |
| PositionPerCycle               | Current position per cycle                           | Operation cycle (FB is starting) | LREAL         | LIST_READ_ONLY | The current position per cycle is stored in the range from 0.0 to (Length per cycle - 0.00001). The current position after phase compensation processing can be monitored.<br>The unit is that of the input axis set in Master axis (Master) of MCv_AdvancedSync (Advanced synchronous control).                                                                                                                                |
| ReferenceSetPosition           | Cam reference position                               | Operation cycle (FB is starting) | LREAL         | LIST_READ_ONLY | The set position to be the cam reference position of the cam operation is stored.<br>The set position unit is that of the axis set to Axis information ( <u>AdvOutputName</u> .Axis) on the output axis.                                                                                                                                                                                                                        |
| SetPosition                    | Cam set position                                     | Operation cycle (FB is starting) | LREAL         | LIST_READ_ONLY | The cam axis set position is stored.<br>The set position unit is that of the axis set to Axis information ( <u>AdvOutputName</u> .Axis) on the output axis.                                                                                                                                                                                                                                                                     |
| CamNo                          | Execution profile number                             | Operation cycle (FB is starting) | WORD (UINT)   | LIST_READ_ONLY | The cam number currently being executed is stored. When Cam number ( <u>AdvOutputName</u> .Pr.Cam.CamNo) is changed during synchronous control, the value is updated when the cam number actually being controlled is switched. The same value is also stored in Execution profile ID number ( <u>AxisName</u> .Md.ProfileID).                                                                                                  |
| StrokeAmount                   | Execution cam stroke amount                          | Operation cycle (FB is starting) | LREAL         | LIST_READ_ONLY | The cam stroke amount currently being executed is stored.<br>When Cam stroke amount ( <u>AdvOutputName</u> .Pr.Cam.StrokeAmount) is changed during synchronous control, the value is updated when the cam stroke amount actually being controlled is switched.                                                                                                                                                                  |
| LengthPerCycle                 | Length per execution cycle                           | Operation cycle (FB is starting) | LREAL         | LIST_READ_ONLY | The length per cycle of the cam currently being executed is stored.<br>When Length per cycle ( <u>AdvOutputName</u> .Pr.Cam.LengthPerCycle) is changed during synchronous control, the value is updated when the length per cycle actually being controlled is switched.                                                                                                                                                        |
| SyncControlChangeStatus        | Synchronous control change status                    | Operation cycle (FB is starting) | INT           | LIST_READ_ONLY | The status where the synchronous control change is applied upon Synchronous control change request ( <u>AdvOutputName</u> .Cd.Cam.SyncControlChangeRequest) is stored.<br><ul style="list-style-type: none"> <li>• -1: Synchronous control change failed</li> <li>• 0: No synchronous control change request</li> <li>• 1: Synchronous control change in progress</li> <li>• 2: Synchronous control change completed</li> </ul> |
| StartingPoint                  | Execution cam start point                            | Operation cycle (FB is starting) | DWORD (UDINT) | LIST_READ_ONLY | The cam start point currently being executed is stored. When Cam start point ( <u>AdvOutputName</u> .Pr.Cam.StartingPoint) is changed during synchronous control, the value is updated when the cam is switched.                                                                                                                                                                                                                |

## ADV\_CAM\_CMD (Cam control data)

| Variable name             | Name                                             | Import                           | Data type                                                                                                                                                | Attribute       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------|--------------------------------------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SyncControlChangeRequest  | Synchronous control change request               | Operation cycle (FB is starting) | BOOL                                                                                                                                                     | LIST_READ_ONLY  | A synchronous control change request is made. When TRUE (Synchronous control change request) is set, Synchronous control change instruction ( <u>AdvOutputName.Cd.Cam.SyncControlChangeCommand</u> ) is executed. <ul style="list-style-type: none"> <li>FALSE: No synchronous control change request</li> <li>TRUE: Synchronous control change request</li> </ul>                                                                                                                                                                              |
| SyncControlChangeCommand  | Synchronous control change instruction           | Operation cycle (FB is starting) | INT<br>(MC_SYNC_CHANGE_COMMAND)<br> Page 1526<br>MC_SYNC_CHANGE_COMMAND | LIST_READ_ONLY  | The synchronous control change instruction is set. <ul style="list-style-type: none"> <li>0: Cam reference position movement (ReferenceSetPositionMovement)</li> <li>1: Current position change per cycle (ChangeCurrentPositionPerCycle)</li> <li>2: Current position change per cycle after master axis gear (ChangeMasterGearPositionPerCycle)</li> <li>3: Current position change per cycle after auxiliary axis gear (ChangeAuxGearPositionPerCycle)</li> <li>4: Current position movement per cycle (PositionPerCycleMovement)</li> </ul> |
| SyncControlChange         | Synchronous control change value                 | Operation cycle (FB is starting) | LREAL                                                                                                                                                    | LIST_READ_ONLY  | The synchronous control change processing change value is set. <ul style="list-style-type: none"> <li>-2147483648.0 to 2147483647.0</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                  |
| SyncControlReflectionTime | Synchronous control change reflection time       | Operation cycle (FB is starting) | WORD (UINT)                                                                                                                                              | LIST_READ_ONLY  | The synchronous control change processing reflection time is set. <ul style="list-style-type: none"> <li>0 to 65535 [ms]</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                             |
| OutSmoothingTimeConstant  | Output axis smoothing time constant change value | At start                         | INT                                                                                                                                                      | LIST_WRITE_BACK | The output axis smoothing time constant is changed. <ul style="list-style-type: none"> <li>0 to 5000 [ms]</li> </ul> *: Smoothing is not performed if a negative value is set.<br>*: When "0" is set, smoothing is performed with the setting value of Output axis smoothing time constant ( <u>AdvOutputName.PrConst.SmoothingTimeConstant</u> ).                                                                                                                                                                                              |

## ADV\_RESTORE\_PARAM (Synchronous control initial position parameter)

| Variable name                     | Name                                                                    | Import   | Data type                                                                                                                                                    | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------|-------------------------------------------------------------------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MasterGearPositionPerCycleMethod  | Setting method for current position per cycle after master axis gear    | At start | INT<br>(MC_GEAR_RESTORE_METHOD)<br> Page 1526<br>MC_GEAR_RESTORE_METHOD     | LIST_WRITE<br>_BACK | The setting method for Current position per cycle after master axis gear<br>(AdvOutputName.Md.Gear.MasterGearPositionPerCycle) is set at start of MCv_AdvancedSync (Advanced synchronous control).<br><ul style="list-style-type: none"> <li>• 0: Last value (PreviousPosition)</li> <li>• 1: Default setting value for current position per cycle after master axis gear (InitialGearPositionPerCycle)</li> <li>• 2: Calculated from input axis (CalculateFromInputAxis)</li> </ul>                                                                         |
| MasterGearInitialPositionPerCycle | Current position default value per cycle after master axis gear         | At start | LREAL                                                                                                                                                        | LIST_WRITE<br>_BACK | The initial setting value of the current position per cycle after master axis gear is set when Setting method for current position per cycle after master axis gear<br>(AdvOutputName.Md.Gear.MasterGearPositionPerCycleMethod) is set to "1: Default setting value for current position per cycle after master axis gear (InitialGearPositionPerCycle)". The setting range is "0.0 to (Length per cycle - 0.00001)".<br><ul style="list-style-type: none"> <li>• 0.0 to 2147483647.0</li> </ul>                                                             |
| AuxGearPositionPerCycleMethod     | Setting method for current position per cycle after auxiliary axis gear | At start | INT<br>(MC_GEAR_RESTORE_METHOD)<br> Page 1526<br>MC_GEAR_RESTORE_METHOD     | LIST_WRITE<br>_BACK | The setting method for Current position per cycle after auxiliary axis gear<br>(AdvOutputName.Md.Gear.AuxGearPositionPerCycle) is set at the start of MCv_AdvancedSync (Advanced synchronous control).<br><ul style="list-style-type: none"> <li>• 0: Last value (PreviousPosition)</li> <li>• 1: Default setting value for current position per cycle after auxiliary axis gear (InitialGearPositionPerCycle)</li> <li>• 2: Calculated from input axis (CalculateFromInputAxis)</li> </ul>                                                                  |
| AuxGearInitialPositionPerCycle    | Current position default value per cycle after auxiliary axis gear      | At start | LREAL                                                                                                                                                        | LIST_WRITE<br>_BACK | The initial setting value of the current position per cycle after auxiliary axis gear is set when Setting method for current position per cycle after auxiliary axis gear<br>(AdvOutputName.Md.Gear.AuxGearPositionPerCycle) is set to "1: Default setting value for current position per cycle after auxiliary axis gear (InitialGearPositionPerCycle)". The setting range is "0.0 to (Length per cycle - 0.00001)".<br><ul style="list-style-type: none"> <li>• 0.0 to 2147483647.0</li> </ul>                                                             |
| PositionRestorationObject         | Cam axis position restoration target                                    | At start | INT<br>(MC_CAM_RESTORE_METHOD)<br> Page 1527<br>MC_CAM_RESTORE_METHOD     | LIST_WRITE<br>_BACK | The target to be restored at start of synchronous control is set.<br><ul style="list-style-type: none"> <li>• 0: Current position restoration per cycle (RestorePositionPerCycle)</li> <li>• 1: Cam reference position restoration (RestoreReferenceSetPosition)</li> <li>• 2: Cam set position restoration (RestoreCamSetPosition)</li> </ul>                                                                                                                                                                                                               |
| ReferenceSetPositionMethod        | Cam reference position setting method                                   | At start | INT<br>(MC_CAM_REFERENCE_METHOD)<br> Page 1527<br>MC_CAM_REFERENCE_METHOD | LIST_WRITE<br>_BACK | The setting method for the cam reference position to be used for restoration is set when Cam axis position restoration target<br>(AdvOutputName.Pr.Restore.PositionRestorationObject) is set to "0: Current position restoration per cycle (RestorePositionPerCycle)" or "2: Cam set position restoration (RestoreCamSetPosition)".<br><ul style="list-style-type: none"> <li>• 0: Last value (PreviousPosition)</li> <li>• 1: Cam reference position default value (InitialReferenceSetPosition)</li> <li>• 2: Cam set position (CamSetPosition)</li> </ul> |
| InitialReferenceSetPosition       | Cam reference position default value                                    | At start | LREAL                                                                                                                                                        | LIST_WRITE<br>_BACK | The initial setting value of the cam reference position is set in the unit that of the axis set to Axis information<br>(AdvOutputName.Axis) on the output axis when Cam reference position setting method<br>(AdvOutputName.Pr.Restore.PositionRestorationMethod) is set to "1: Cam reference position default value (InitialReferenceSetPosition)".<br><ul style="list-style-type: none"> <li>• -10000000000.0 to 10000000000.0</li> </ul>                                                                                                                  |



| Variable name                | Name                                                                 | Import   | Data type                                                                                                                                          | Attribute           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------|----------------------------------------------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PositionPerCycleMethod       | Setting method for current position per cycle                        | At start | INT<br>(MC_CAM_CYCLE_METHOD)<br> Page 1527<br>MC_CAM_CYCLE_METHOD | LIST_WRITE<br>_BACK | The setting method for the current position per cycle to be used for restoration is set when Cam axis position restoration target<br>(AdvOutputName.Pr.Restore.PositionRestorationObject) is set to "1: Cam reference position restoration (RestorePositionPerCycle)" or "2: Cam set position restoration (RestoreCamSetPosition)".<br><ul style="list-style-type: none"> <li>• 0: Last value (PreviousPosition)</li> <li>• 1: Current position default value per cycle (InitialPositionPerCycle)</li> <li>• 2: Current position per cycle after master axis gear (MasterGearPositionPerCycle)</li> <li>• 3: Current position per cycle after auxiliary axis gear (AuxGearPositionPerCycle)</li> </ul> |
| InitialPositionPerCycle      | Current position default value per cycle                             | At start | LREAL                                                                                                                                              | LIST_WRITE<br>_BACK | A value is set according to the Cam axis position restoration target<br>(AdvOutputName.Pr.Restore.PositionRestorationObject) setting.<br>The unit is that of the input axis set to Master axis (Master) of MCv_AdvancedSync (Advanced synchronous control).<br>The setting range is "0.0 to (Length per cycle - 0.00001)".<br><ul style="list-style-type: none"> <li>• 0.0 to 2147483647.0</li> </ul>                                                                                                                                                                                                                                                                                                  |
| RestorationAllowablePosition | Cam set position restoration allowable movement amount setting value | At start | DWORD (UDINT)                                                                                                                                      | LIST_WRITE<br>_BACK | The allowable value of the difference between the restored cam set position and the set position is set in the unit of the set position value of the output axis when Cam axis position restoration target<br>(AdvOutputName.Pr.Restore.PositionRestorationObject) is set to "2: Cam set position restoration".<br>If the setting value is too large, abrupt movements may occur when synchronization starts.<br><ul style="list-style-type: none"> <li>• 0.0 to 2147483647.0 [pulse]</li> </ul>                                                                                                                                                                                                       |

## 44.2 List of Enumerators

This section lists enumerators used for various parameters, monitor data, and motion control FBs.

### ENUM enumerators

The enumeration type constant used for various parameters, monitor data, and Motion control FBs actually uses INT type values.

"Enumeration type name\_\_enumerator" INT type global labels are available on the engineering tool.

**Ex.**

When using MC\_BUFFER\_MODE type enumerator "mcBuffered" on the engineering tool

- When using an INT type global label: Set "MC\_BUFFER\_MODE\_\_mcBuffered".

#### MC\_BUFFER\_MODE

| Enumerator         | Setting value | Description      |
|--------------------|---------------|------------------|
| mcAborting         | 0             | Aborting         |
| mcBuffered         | 1             | Buffered         |
| mcBlendingLow      | 2             | BlendingLow      |
| mcBlendingPrevious | 3             | BlendingPrevious |
| mcBlendingNext     | 4             | BlendingNext     |
| mcBlendingHigh     | 5             | BlendingHigh     |

#### MC\_EXECUTION\_MODE

| Enumerator      | Setting value | Description           |
|-----------------|---------------|-----------------------|
| mcImmediately   | 0             | Execute immediately   |
| mcQueued        | 1             | Execute at completion |
| mcSpeculatively | 3             | Execute speculatively |

#### MC\_COMBINE\_MODE

| Enumerator | Setting value | Description                        |
|------------|---------------|------------------------------------|
| mcAddAxes  | 0             | Add positions of 2 input axes      |
| mcSubAxes  | 1             | Subtract positions of 2 input axes |

#### MC\_DIRECTION

| Enumerator          | Setting value | Description        |
|---------------------|---------------|--------------------|
| mcPositiveDirection | 1             | Positive direction |
| mcNegativeDirection | 2             | Negative direction |
| mcShortestWay       | 3             | Shortest path      |
| mcCurrentDirection  | 4             | Current direction  |

#### MC\_SOURCE

| Enumerator          | Setting value | Description         |
|---------------------|---------------|---------------------|
| mcSetValue          | 1             | Set value           |
| mcActualValue       | 2             | Actual value        |
| mcLatestSetValue    | 101           | Latest set value    |
| mcLatestActualValue | 102           | Latest actual value |

## MC\_CIRC\_MODE

| Enumerator | Setting value | Description                |
|------------|---------------|----------------------------|
| mcBorder   | 0             | Border point specification |
| mcCenter   | 1             | Center point specification |
| mcRadius   | 2             | Radius specification       |

## MC\_CIRC\_PATHCHOICE

| Enumerator   | Setting value | Description |
|--------------|---------------|-------------|
| mcCW         | 0             | CW          |
| mcCCW        | 1             | CCW         |
| mcShortWay   | 2             | Shortcut    |
| mcLongWay    | 3             | Detour      |
| mcCWLongWay  | 4             | CW detour   |
| mcCCWLongWay | 5             | CCW detour  |

## MC\_START\_MODE

| Enumerator  | Setting value | Description |
|-------------|---------------|-------------|
| mcImmediate | 0             | Immediately |
| mcAbsolute  | 1             | Absolute    |

## MC\_AXIS\_STATUS

| Enumerator         | Setting value | Description                                        |
|--------------------|---------------|----------------------------------------------------|
| Invalid            | -1            | Axis variable not initialized/axis parameter error |
| Disabled           | 0             | Axis disabled                                      |
| ErrorStop          | 1             | Stopping on error                                  |
| Stopping           | 2             | Decelerating to stop                               |
| Homing             | 3             | During home position return                        |
| Standstill         | 4             | Standby                                            |
| DiscreteMotion     | 5             | During positioning operation                       |
| ContinuousMotion   | 6             | During continuous operation                        |
| SynchronizedMotion | 7             | During synchronous operation                       |

## MC\_AXES\_GROUP\_STATUS

| Enumerator     | Setting value | Description                                                    |
|----------------|---------------|----------------------------------------------------------------|
| Invalid        | -1            | Axes group variable not initialized/axes group parameter error |
| GroupDisabled  | 0             | Axes group disabled                                            |
| GroupErrorStop | 1             | Stopping on error                                              |
| GroupStopping  | 2             | Decelerating to stop                                           |
| GroupStandby   | 4             | Standby                                                        |
| GroupMoving    | 5             | Operating                                                      |

## MC\_DRIVE\_MODE

| Enumerator   | Setting value | Description                                      |
|--------------|---------------|--------------------------------------------------|
| NoModeChange | 0             | Do not change                                    |
| hm           | 6             | hm (Homing mode)                                 |
| csp          | 8             | csp (Cyclic synchronous position mode)           |
| csv          | 9             | csv (Cyclic synchronous velocity mode)           |
| cst          | 10            | cst (Cyclic synchronous torque mode)             |
| ct           | -104          | ct (Continuous operation to torque control mode) |

## MC\_VELOCITY\_LIMIT\_MODE

| Enumerator       | Setting value | Description                          |
|------------------|---------------|--------------------------------------|
| Ignore           | 0             | Ignore                               |
| Truncate         | 2             | Truncate                             |
| ImmediateStop    | 3             | Immediate stop                       |
| ClampWithoutRamp | 4             | Clamp (Without ramp at deceleration) |

## MC\_INTERPOLATE\_SPEED\_MODE

| Enumerator         | Setting value | Description          |
|--------------------|---------------|----------------------|
| VectorSpeed        | 0             | Vector speed         |
| LongAxisSpeed      | 1             | Long axis speed      |
| ReferenceAxisSpeed | 2             | Reference axis speed |

## MC\_RECORD\_MODE

| Enumerator  | Setting value | Description              |
|-------------|---------------|--------------------------|
| OneShot     | 0             | One shot mode            |
| RecordCount | 1             | Frequency specified mode |
| RingBuffer  | 2             | Ring buffer mode         |

## MC\_CAM\_CURVE\_TYPE

| Enumerator                  | Setting value | Description               |
|-----------------------------|---------------|---------------------------|
| ConstantSpeed               | 0             | Constant speed            |
| ConstantAcceleration        | 1             | Constant acceleration     |
| DistortedTrapezoid          | 2             | Distorted trapezoid       |
| DistortedSine               | 3             | Distorted sine            |
| DistortedConstantSpeed      | 4             | Distorted constant speed  |
| Cycloid                     | 5             | Cycloid                   |
| FifthCurve                  | 6             | 5th curve                 |
| Trapecloid                  | 7             | Trapecloid                |
| ReverseTrapecloid           | 8             | Reverse trapecloid        |
| DoubleHypotenuse            | 9             | Double hypotenuse         |
| ReverseDoubleHypotenuse     | 10            | Reverse double hypotenuse |
| SingleHypotenuse            | 11            | Single hypotenuse         |
| FifthCurve_SpeedDesignation | 12            | 5th curve (Adjustment)    |

## MC\_AXIS\_TYPE

| Enumerator         | Setting value | Description          |
|--------------------|---------------|----------------------|
| DriveAxis          | 0             | Real drive axis      |
| EncoderAxis        | 2             | Real encoder axis    |
| VirtualDriveAxis   | 3             | Virtual drive axis   |
| VirtualEncoderAxis | 4             | Virtual encoder axis |
| VirtualLinkAxis    | 5             | Virtual link axis    |

## MC\_ENCODER\_AXIS\_TYPE

| Enumerator | Setting value | Description    |
|------------|---------------|----------------|
| Drive      | 1             | Via drive unit |

## MC\_ABS\_SYSTEM

| Enumerator  | Setting value | Description                                       |
|-------------|---------------|---------------------------------------------------|
| ABSDisabled | 0             | Disable absolute position system                  |
| Enabled     | 1             | Enable absolute position system                   |
| Auto        | -1            | Automatic setting (Acquire from connected device) |

## MC\_DRIVE\_STATE

| Enumerator          | Setting value | Description            |
|---------------------|---------------|------------------------|
| NotReadyToSwitchOn  | 0             | Not Ready To Switch On |
| Fault               | 1             | Fault                  |
| FaultReactionActive | 2             | Fault Reaction Active  |
| SwitchOnDisabled    | 3             | Switch On Disabled     |
| ReadyToSwitchOn     | 4             | Ready To Switch On     |
| SwitchedOn          | 5             | Switched On            |
| OperationEnable     | 6             | Operation Enable       |
| QuickStopActive     | 7             | Quick Stop Active      |
| Invalid             | -1            | Invalid                |

## MC\_DECEL\_STOP\_MODE

| Enumerator                 | Setting value | Description                            |
|----------------------------|---------------|----------------------------------------|
| Ignore                     | 0             | Ignore                                 |
| ImmediateStop              | 1             | Immediate stop                         |
| KeepCurrentAcc             | 2             | Keep current acceleration/deceleration |
| AlternativeAcc             | 3             | Alternative acceleration/deceleration  |
| ServoOffAfterImmediateStop | 4             | Servo OFF after immediate stop         |
| ServoOffAfterDecelStop     | 5             | Servo OFF after deceleration to stop   |

## MC\_STOP\_CURVE\_MODE

| Enumerator    | Setting value | Description                 |
|---------------|---------------|-----------------------------|
| OverrideCurve | 1             | Recreate deceleration curve |

## MC\_POS\_SOURCE

| Enumerator          | Setting value | Description           |
|---------------------|---------------|-----------------------|
| Invalid             | -1            | Invalid               |
| SetPosition         | 1             | Set position          |
| FeedMachinePosition | 3             | Feed machine position |

## MC\_ACC\_ZERO\_MODE

| Enumerator          | Setting value | Description                       |
|---------------------|---------------|-----------------------------------|
| ACCError            | -1            | Error (not started)               |
| MaximumAcceleration | 1             | Maximum acceleration/deceleration |

## MC\_SIGNAL\_LOGIC

| Enumerator  | Setting value | Description                              |
|-------------|---------------|------------------------------------------|
| HighLevel   | 0             | Detection at TRUE                        |
| LowLevel    | 1             | Detection at FALSE                       |
| RisingEdge  | 2             | Detection at FALSE → TRUE (rising edge)  |
| FallingEdge | 3             | Detection at TRUE → FALSE (falling edge) |
| BothEdges   | 4             | Detection at rising edge/falling edge    |

## MC\_ERROR\_CLASS

| Enumerator    | Setting value | Description    |
|---------------|---------------|----------------|
| _None         | 0             | None           |
| Warning       | 1             | Warning        |
| MinorError    | 2             | Minor error    |
| ModerateError | 3             | Moderate error |
| MajorError    | 4             | Major error    |

## MC\_EXECUTION\_STATE

| Enumerator | Setting value | Description               |
|------------|---------------|---------------------------|
| Ready      | 0             | Waiting execution request |
| Executing  | 1             | Executing                 |
| Done       | 2             | Execution completed       |
| Error_     | -1            | Error occurrence          |

## MC\_POS\_RESTORE\_STATUS

| Enumerator                 | Setting value | Description                                                             |
|----------------------------|---------------|-------------------------------------------------------------------------|
| NotExecute                 | 0             | Not executed                                                            |
| WaitingRequest             | 1             | Waiting restoration request                                             |
| RestoredInIncSystem        | 2             | Restoration completed by incremental system                             |
| RestoredInAbsSystemUnHomed | 3             | Restored in absolute position system (Home position return uncompleted) |
| RestoredInAbsSystem        | 4             | Restored in absolute position system                                    |

## MC\_AXES\_GROUP\_TYPE

| Enumerator | Setting value | Description |
|------------|---------------|-------------|
| Standard   | 0             | Standard    |

## MC\_OPERATION\_PATTERN

| Enumerator                 | Setting value | Description                        |
|----------------------------|---------------|------------------------------------|
| PositioningComplete        | 0             | Positioning completed              |
| ContinuousPositioning      | 1             | Continuous positioning             |
| ContinuousBlendingLow      | 2             | Continuous path (BlendingLow)      |
| ContinuousBlendingPrevious | 3             | Continuous path (BlendingPrevious) |
| ContinuousBlendingNext     | 4             | Continuous path (BlendingNext)     |
| ContinuousBlendingHigh     | 5             | Continuous path (BlendingHigh)     |

## MC\_CONTROL\_METHOD

| Enumerator       | Setting value | Description                           |
|------------------|---------------|---------------------------------------|
| NOP              | 128           | NOP                                   |
| JUMP             | 130           | JUMP                                  |
| LOOP             | 131           | LOOP                                  |
| LEND             | 132           | LEND                                  |
| LinearAbsolute   | 257           | Absolute value linear interpolation   |
| LinearRelative   | 258           | Relative value linear interpolation   |
| CircularAbsolute | 259           | Absolute value circular interpolation |
| CircularRelative | 260           | Relative value circular interpolation |
| HelicalAbsolute  | 261           | Absolute value helical interpolation  |
| HelicalRelative  | 262           | Relative value helical interpolation  |

## MC\_MCODE\_OUTPUT\_OVERRIDE

| Enumerator   | Setting value | Description    |
|--------------|---------------|----------------|
| UseFbOptions | 0             | Use FB options |
| WithMode     | 1             | WITH mode      |
| AfterMode    | 2             | AFTER mode     |

## MC\_STEP\_MODE

| Enumerator             | Setting value | Description                |
|------------------------|---------------|----------------------------|
| Ignored                | 0             | Ignore                     |
| StepPerDec             | 1             | Deceleration unit step     |
| StepPerPositioningData | 2             | Positioning data unit step |

## MC\_POS\_RESTORATION\_BASE

| Enumerator     | Setting value | Description             |
|----------------|---------------|-------------------------|
| BackupPosition | 0             | Backup position         |
| HomePosition   | 1             | Home position           |
| Auto           | -1            | Automatic determination |

## MC\_POS\_RESTORATION\_REQUEST

| Enumerator                     | Setting value | Description                                                               |
|--------------------------------|---------------|---------------------------------------------------------------------------|
| NoRequest                      | 0             | No operation                                                              |
| RestorationRequest             | 1             | Current position restoration execution                                    |
| RestorationRequest_EraseAbsPos | 2             | Current position restoration execution in absolute position erased status |

## MC\_INPUT\_DIRECTION

| Enumerator             | Setting value | Description                                                       |
|------------------------|---------------|-------------------------------------------------------------------|
| NoDirectionRestriction | 0             | No moving direction restriction                                   |
| mcPositiveDirection    | 1             | Allowed only when the current position is in increasing direction |
| mcNegativeDirection    | 2             | Allowed only when the current position is in decreasing direction |

## MC\_CLUTCH\_METHOD

| Enumerator         | Setting value | Description                 |
|--------------------|---------------|-----------------------------|
| NoClutch           | 0             | Invalid                     |
| ClutchCommand      | 1             | Clutch command              |
| ClutchLeadingEdge  | 2             | Clutch command rising edge  |
| ClutchTrailingEdge | 3             | Clutch command falling edge |
| ClutchAddress      | 4             | Address mode                |
| ClutchSignal       | 15            | I/O data specification      |

## MC\_CLUTCH\_REFERENCE

| Enumerator           | Setting value | Description                           |
|----------------------|---------------|---------------------------------------|
| GearFrontPosition    | 0             | Current position before gear          |
| GearPositionPerCycle | 1             | Current position per cycle after gear |

## MC\_CLUTCH\_SMOOTHING\_METHOD

| Enumerator              | Setting value | Description                                             |
|-------------------------|---------------|---------------------------------------------------------|
| ClutchSmoothingDisabled | 0             | Direct                                                  |
| TimeConstantExponent    | 1             | Time constant method (exponent)                         |
| TimeConstantLinear      | 2             | Time constant method (linear)                           |
| SlippageExponent        | 3             | Slippage amount method (exponent)                       |
| SlippageLinear          | 4             | Slippage amount method (linear)                         |
| SlippageLinearFollow    | 5             | Slippage amount method (linear: input amount follow-up) |

## MC\_LENGTH\_PER\_CYCLE\_CHANGE

| Enumerator          | Setting value | Description |
|---------------------|---------------|-------------|
| LengthChangeInvalid | 0             | Invalid     |
| LengthChangeValid   | 1             | Valid       |

## MC\_SYNC\_CHANGE\_COMMAND

| Enumerator                       | Setting value | Description                                                 |
|----------------------------------|---------------|-------------------------------------------------------------|
| ReferenceSetPositionMovement     | 0             | Cam reference position movement                             |
| ChangeCurrentPositionPerCycle    | 1             | Current position change per cycle                           |
| ChangeMasterGearPositionPerCycle | 2             | Current position change per cycle after master axis gear    |
| ChangeAuxGearPositionPerCycle    | 3             | Current position change per cycle after auxiliary axis gear |
| PositionPerCycleMovement         | 4             | Current position movement per cycle                         |

## MC\_GEAR\_RESTORE\_METHOD

| Enumerator                  | Setting value | Description                                         |
|-----------------------------|---------------|-----------------------------------------------------|
| PreviousPosition            | 0             | Last value                                          |
| InitialGearPositionPerCycle | 1             | Current position default value per cycle after gear |
| CalculateFromInputAxis      | 2             | Calculated from input axis                          |



## MC\_CAM\_RESTORE\_METHOD

| Enumerator                  | Setting value | Description                            |
|-----------------------------|---------------|----------------------------------------|
| RestorePositionPerCycle     | 0             | Current position restoration per cycle |
| RestoreReferenceSetPosition | 1             | Cam reference position restoration     |
| RestoreCamSetPosition       | 2             | Cam set position restoration           |

## MC\_CAM\_REFERENCE\_METHOD

| Enumerator                  | Setting value | Description                          |
|-----------------------------|---------------|--------------------------------------|
| PreviousPosition            | 0             | Last value                           |
| InitialReferenceSetPosition | 1             | Cam reference position default value |
| CamSetPosition              | 2             | Set position                         |

## MC\_CAM\_CYCLE\_METHOD

| Enumerator                 | Setting value | Description                                          |
|----------------------------|---------------|------------------------------------------------------|
| PreviousPosition           | 0             | Last value                                           |
| InitialPositionPerCycle    | 1             | Current position default value per cycle             |
| MasterGearPositionPerCycle | 2             | Current position per cycle after master axis gear    |
| AuxGearPositionPerCycle    | 3             | Current position per cycle after auxiliary axis gear |

# 45 ADMINISTRATIVE FUNCTION BLOCKS

## 45.1 Axes Group Enabled

### MC\_GroupEnable

This FB changes the specified Axes group status (AxesGroupName.Md.GroupStatus) from "0: Axes group disabled (GroupDisabled)" to "4: Standby (GroupStandby)" and enables the axes group.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                          |
|----------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_GroupEnable(   AxesGroup:= ?AXES_GROUP_REF? ,   Execute:= ?BOOL? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### ■ I/O variables

| I/O variable | Name                   | Data type      | Input    | Setting range | Default value         | Description                                                                                                                                                                              |
|--------------|------------------------|----------------|----------|---------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxesGroup    | Axes group information | AXES_GROUP_REF | At start | —             | Omission not possible | An axes group is set.<br>For the variable ( <u>AxesGroupName</u> .AxesGroupRef.) used, refer to the following.<br>Page 1468 <u>AxesGroupName</u> .AxesGroupRef. (Axes group information) |

#### ■ Input variable

| Input variable | Name              | Data type | Input    | Setting range | Default value | Description                                                                         |
|----------------|-------------------|-----------|----------|---------------|---------------|-------------------------------------------------------------------------------------|
| Execute        | Execution command | BOOL      | At start | TRUE, FALSE   | FALSE         | When this variable is set to TRUE, MC_GroupEnable (Axes Group Enabled) is executed. |

#### ■ Output variables

| Output variable | Name                 | Data type  | Default value | Description                                                                                                                                                                                                                    |
|-----------------|----------------------|------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion | BOOL       | FALSE         | This variable becomes TRUE when the axes group status transits to "4: Standby (GroupStandby)".                                                                                                                                 |
| Busy            | Executing            | BOOL       | FALSE         | This variable becomes TRUE while MC_GroupEnable (Axes Group Enabled) is being executed.<br>This variable becomes FALSE when Axes Group Status ( <u>AxesGroupName</u> .Md.GroupStatus) transits to "4: Standby (GroupStandby)". |
| Error           | Error                | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                               |
| ErrorID         | Error code           | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used                                                                    |

## Processing details

- This FB changes Axes group status (AxesGroupName.Md.GroupStatus) of the AXES\_GROUP\_REF structure from "0: Axes group disabled (GroupDisabled)" to "4: Standby (GroupStandby)".
- MC\_GroupEnable (Axes Group Enabled) is executed when Execution command (Execute) becomes TRUE, and Executing (Busy) becomes TRUE when the processing is started normally.
- When the processing is completed successfully, Execution completion (Done) becomes TRUE and Executing (Busy) becomes FALSE.
- When an error occurs in MC\_GroupEnable (Axes Group Enabled), Error (Error) becomes TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

 User's manual for the controller used

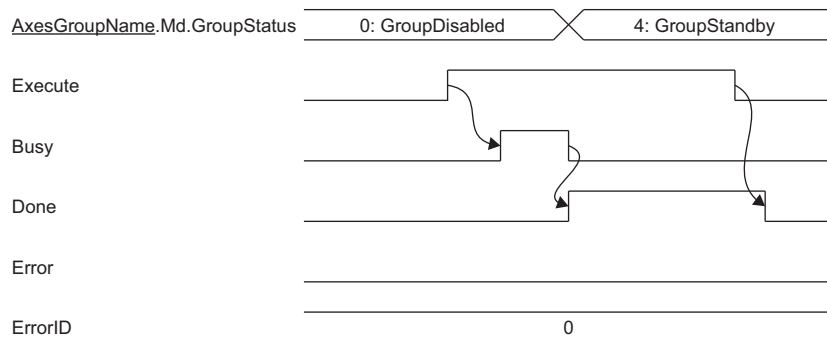
- For the axes group state transition, refer to the following.

 User's manual for the controller used

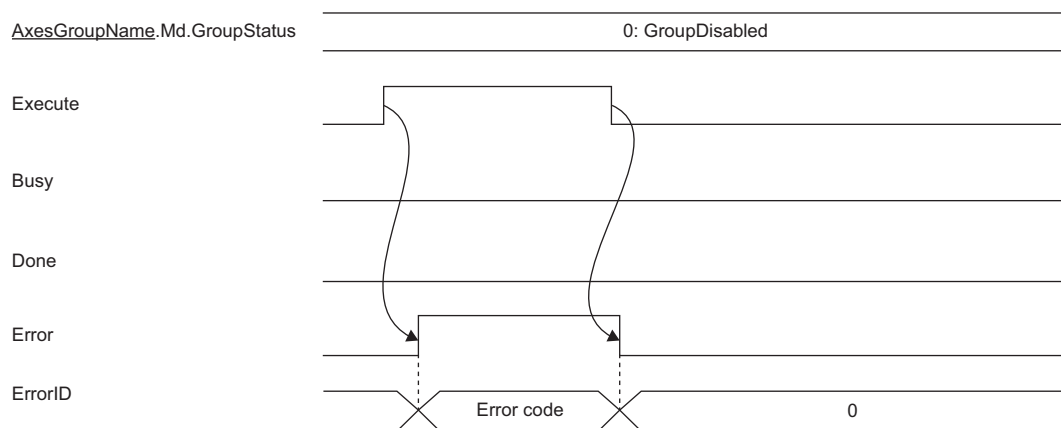
- MC\_GroupEnable (Axes Group Enabled) can be executed only when Axis Status (AxisName.Md.AxisStatus) of all configuration axes is "4: Standby (Standstill)" or "0: Axis disabled (Disabled)".
- Using axes group (AxisName.Md.UseInGroup) becomes TRUE when Axes group status (AxesGroupName.Md.GroupStatus) changes to "4: Standby (GroupStandby)".
- When MC\_GroupEnable (Axes Group Enabled) is executed while another axes group including a configuration axis for which Using axes group (AxisName.Md.UseInGroup) is TRUE is being set, Axes Group Configuration Axis Is in Use (error code: 1BB8H) occurs.
- If the error occurs in any of the configuration axes, Axes group status (AxesGroupName.Md.GroupStatus) changes to "1: Stopping on error (GroupErrorStop)".
- When MC\_GroupEnable (Axes Group Enabled) is executed for an axes group that has already been enabled, Execution completion (Done) becomes TRUE and the execution ends.

## ■Timing chart

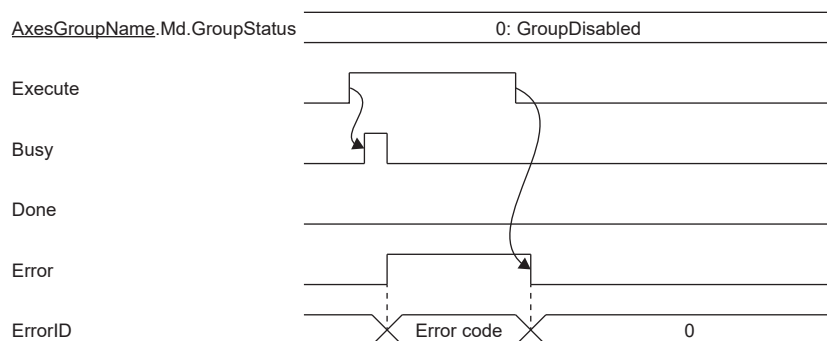
- When the processing is completed successfully



- When I/O variables are abnormal



- When the processing is completed with an error



## Precautions

- Axes group No. (GroupNo) of the AXES\_GROUP\_REF structure must be set in advance before MC\_GroupEnable (Axes Group Enabled) is executed.
- MC\_GroupEnable (Axes Group Enabled) can only be executed when Axis status (AxisName.Md.AxisStatus) of all configuration axes set in the axes group is "4: Standby (Standstill)" or "0: Axis disabled (Disabled)".
- If a parameter error occurs at axes group variable initialization, Out of Parameter Range (Axes Group) (error code: 1A61H) occurs. In this case, Axes group status (AxesGroupName.Md.GroupStatus) changes to "-1: Axes group variable not initialized/Axes group parameter error (Invalid)". Refreshing of the monitor data or others is not executed for axes groups whose status is "-1: Axes group variable not initialized/Axes group parameter error (Invalid)". If the axes group is specified by the user program, Out of Axes Group No. Range (error code: 1B84H) occurs.

## Program example

The following is a program example. The axes group enable command (bGroupEnable) is set to TRUE, and Axes group 1 (AxesGroup001) is enabled.

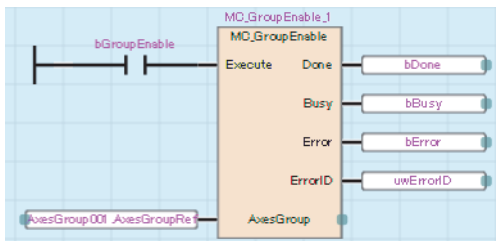
### ■Axes group

| Axes group No. | Label name   | Data type      | Comment      |
|----------------|--------------|----------------|--------------|
| 1              | AxesGroup001 | AXES_GROUP_REF | Axes group 1 |

### ■Labels used

| Label name       | Data type                           | Comment                   |
|------------------|-------------------------------------|---------------------------|
| MC_GroupEnable_1 | MC_GroupEnable                      | Axes Group Enabled FB     |
| bGroupEnable     | Bit                                 | Axes group enable command |
| bDone            | Bit                                 | Execution completion      |
| bBusy            | Bit                                 | Executing                 |
| bError           | Bit                                 | Error                     |
| uwErrorID        | Word [unsigned]/bit string [16-bit] | Error code                |

### ■FBD/LD program



### ■ST program

```
MC_GroupEnable_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bGroupEnable ,
  Done=> bDone ,
  Busy=> bBusy ,
  Error=> bError ,
  ErrorID=> uwErrorID
);
```

### Point

MC\_GroupEnable (Axes Group Enabled) is used in combination with the motion control FB that performs interpolation control. For an example program with interpolation control, refer to the following.

- ☞ Page 1730 Absolute Value Linear Interpolation Control
- ☞ Page 1745 Relative Value Linear Interpolation Control
- ☞ Page 1759 Absolute Value Circular Interpolation Control
- ☞ Page 1776 Relative Value Circular Interpolation Control

## 45.2 Axes Group Disabled

### MC\_GroupDisable

This FB changes the specified Axes group status (AxesGroupName.Md.GroupStatus) to "0: Axes group disabled (GroupDisabled)" and disables the axes group.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                           |
|----------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_GroupDisable(   AxesGroup:= ?AXES_GROUP_REF? ,   Execute:= ?BOOL? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name                   | Data type      | Input    | Setting range | Default value         | Description                                                                                                                                                                              |
|--------------|------------------------|----------------|----------|---------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxesGroup    | Axes group information | AXES_GROUP_REF | At start | —             | Omission not possible | An axes group is set.<br>For the variable ( <u>AxesGroupName</u> .AxesGroupRef.) used, refer to the following.<br>Page 1468 <u>AxesGroupName</u> .AxesGroupRef. (Axes group information) |

#### Input variable

| Input variable | Name              | Data type | Input    | Setting range | Default value | Description                                                                           |
|----------------|-------------------|-----------|----------|---------------|---------------|---------------------------------------------------------------------------------------|
| Execute        | Execution command | BOOL      | At start | TRUE, FALSE   | FALSE         | When this variable is set to TRUE, MC_GroupDisable (Axes Group Disabled) is executed. |

#### Output variables

| Output variable | Name                 | Data type  | Default value | Description                                                                                                                                                                                                                                   |
|-----------------|----------------------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion | BOOL       | FALSE         | This variable becomes TRUE when the axes group status transits to "0: Axes group disabled (GroupDisabled)".                                                                                                                                   |
| Busy            | Executing            | BOOL       | FALSE         | This variable becomes TRUE while MC_GroupDisable (Axes Group Disabled) is being executed.<br>This variable becomes FALSE when Axes Group Status ( <u>AxesGroupName</u> .Md.GroupStatus) transits to "0: Axes group disabled (GroupDisabled)". |
| Error           | Error                | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                              |
| ErrorID         | Error code           | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used                                                                                   |

## Processing details

- This FB changes Axes group status (AxesGroupName.Md.GroupStatus) of the AXES\_GROUP\_REF structure to "0: Axes group disabled (GroupDisabled)".
- MC\_GroupDisable (Axes Group Disabled) is executed when Execution command (Execute) becomes TRUE, and Executing (Busy) becomes TRUE when the processing is started normally.
- When the processing is completed successfully, Execution completion (Done) becomes TRUE and Executing (Busy) becomes FALSE.
- When an error occurs in MC\_GroupDisable (Axes Group Disabled), Error (Error) becomes TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

 User's manual for the controller used

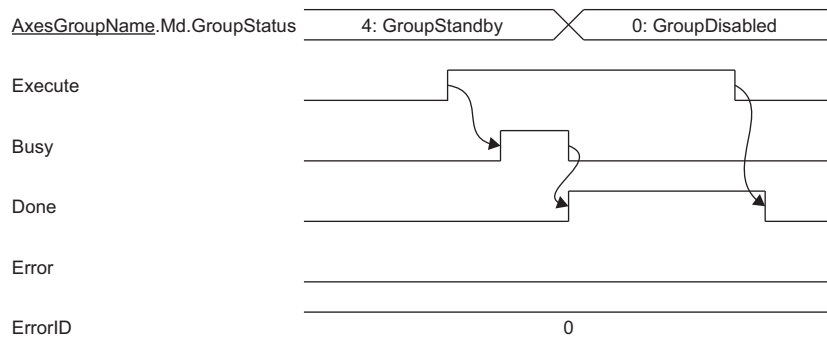
- For the axes group state transition, refer to the following.

 User's manual for the controller used

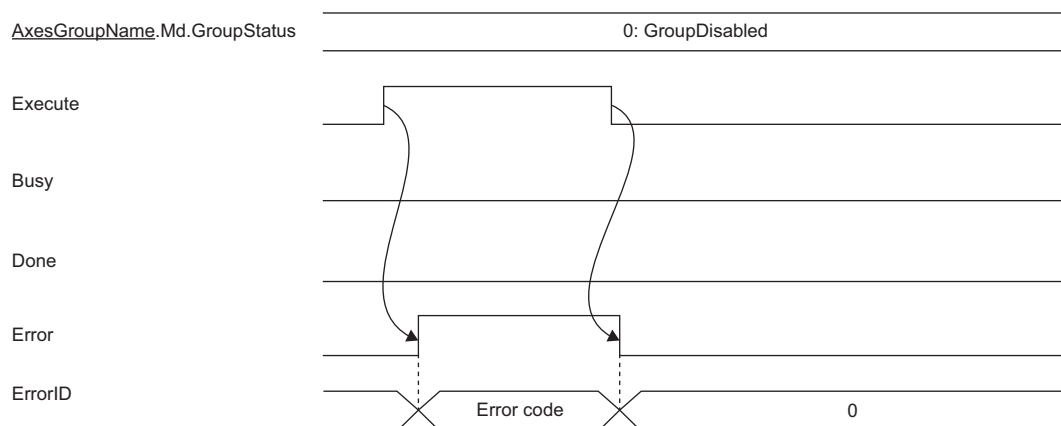
- MC\_GroupDisable (Axes Group Disabled) can only be executed when Axes Group Status (AxesGroupName.Md.GroupStatus) is "4: Standby (GroupStandby)" or "1: Stopping on error (GroupErrorStop)". When executing MC\_GroupDisable (Axes Group Disabled) while the axes group status is "1: Stopping on error (GroupErrorStop)" and the axes group is in operation, the axes group status transits to "0: Axes group disabled (GroupDisabled)" after the stop completes. When MC\_GroupDisable (Axes Group Disabled) is executed while Axes group status (AxesGroupName.Md.GroupStatus) is other than "4: Standby (GroupStandby)" or "1: Stopping on error (GroupErrorStop)", Axes Group Status Incorrect (Axes Group Disable) (error code: 1AEFH) occurs and the FB being executed stops.
- When Axes Group Status (AxesGroupName.Md.GroupStatus) changes to "0: Axes group disabled (GroupDisabled)", Using Axes Group (AxisName.Md.UseInGroup) of the configuration axis becomes FALSE.
- When MC\_GroupDisable (Axes Group Disabled) is executed for an axes group that has already been disabled, Execution completion (Done) becomes TRUE and the execution ends.

## ■Timing chart

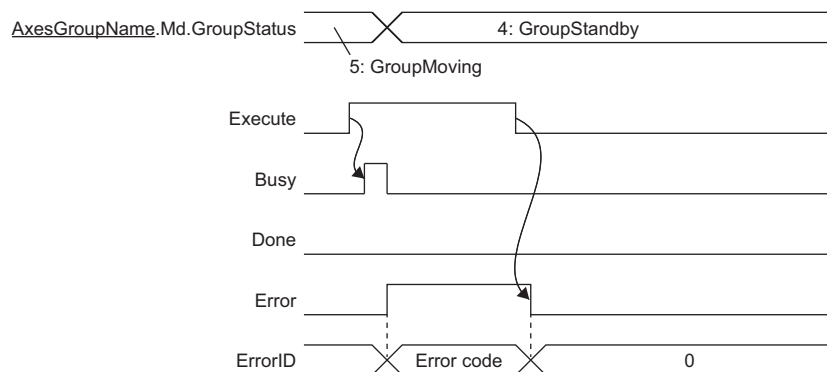
- When the processing is completed successfully



- When I/O variables are abnormal



- When the processing is completed with an error



## Precautions

- Axes group No. (GroupNo) of the AXES\_GROUP\_REF structure must be set in advance before MC\_GroupDisable (Axes Group Disabled) is executed.
- If a parameter error occurs at axes group variable initialization, Out of Parameter Range (Axes Group) (error code: 1A61H) occurs. In this case, Axes group status (AxesGroupName.Md.GroupStatus) changes to "-1: Axes group variable not initialized/Axes group parameter error (Invalid)". Refreshing of the monitor data or others is not executed for axes groups whose status is "-1: Axes group variable not initialized/Axes group parameter error (Invalid)". If the axes group is specified by the user program, Out of Axes Group No. Range (error code: 1B84H) occurs.



## Program example

The following is a program example. The axes group disable command (bGroupDisable) is set to TRUE, and Axes group 1 (AxesGroup001) is disabled.

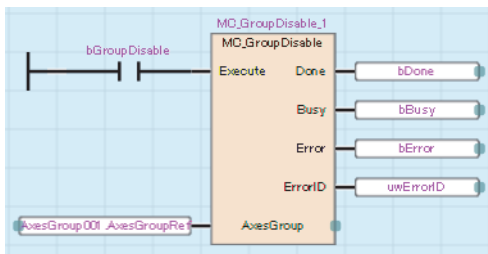
### ■Axes group

| Axes group No. | Label name   | Data type      | Comment      |
|----------------|--------------|----------------|--------------|
| 1              | AxesGroup001 | AXES_GROUP_REF | Axes group 1 |

### ■Labels used

| Label name        | Data type                           | Comment                    |
|-------------------|-------------------------------------|----------------------------|
| MC_GroupDisable_1 | MC_GroupDisable                     | Axes Group Disabled FB     |
| bGroupDisable     | Bit                                 | Axes group disable command |
| bDone             | Bit                                 | Execution completion       |
| bBusy             | Bit                                 | Executing                  |
| bError            | Bit                                 | Error                      |
| uwErrorID         | Word [unsigned]/bit string [16-bit] | Error code                 |

### ■FBD/LD program



### ■ST program

```
MC_GroupDisable_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bGroupDisable ,
  Done=> bDone ,
  Busy=> bBusy ,
  Error=> bError ,
  ErrorID=> uwErrorID
);
```

#### Point

MC\_GroupDisable (Axes Group Disabled) is used in combination with the motion control FB that performs interpolation control. For an example program with interpolation control, refer to the following.

- Page 1730 Absolute Value Linear Interpolation Control
- Page 1745 Relative Value Linear Interpolation Control
- Page 1759 Absolute Value Circular Interpolation Control
- Page 1776 Relative Value Circular Interpolation Control

## 45.3 Operable

### MC\_Power

This FB switches a specified axis to the operation available status.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                           |
|----------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_Power(   Axis:= ?AXIS_REF? ,   Enable:= ?BOOL? ,   ServoON:= ?BOOL? ,   Status=&gt; ?BOOL? ,   ReadyStatus=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### ■I/O variables

| I/O variable | Name             | Data type | Input  | Setting range | Default value         | Description                                                                                                                                                                                                                                                                                                                        |
|--------------|------------------|-----------|--------|---------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | Always | —             | Omission not possible | <p>An axis is specified.</p> <p>For the variable (<u>AxisName</u>.AxisRef.) used, refer to the following.</p> <p>☞ Page 1444 <u>AxisName</u>.AxisRef. (Axis information)</p> <p>* The axis information is established when the FB is called for the first time after "PLC Ready (MotionSystem.Cd.SequenceReady)" is turned on.</p> |

#### ■Input variables

| Input variable | Name             | Data type | Input  | Setting range | Default value | Description                                                                                                                                                                                           |
|----------------|------------------|-----------|--------|---------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable         | Enable           | BOOL      | Always | TRUE, FALSE   | FALSE         | <p>When this variable is set to TRUE, control of the specified axis is enabled (operation possible status).</p> <p>When this variable is set to FALSE, control of the specified axis is disabled.</p> |
| ServoON        | Servo ON request | BOOL      | Always | TRUE, FALSE   | FALSE         | <p>When this variable is set to TRUE, the servo ON is requested to the specified axis.</p>                                                                                                            |

#### ■Output variables

| Output variable | Name            | Data type  | Default value | Description                                                                                                                                                                  |
|-----------------|-----------------|------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Status          | Operable        | BOOL       | FALSE         | This variable becomes TRUE when the axis becomes operation possible status.                                                                                                  |
| ReadyStatus     | Ready ON status | BOOL       | FALSE         | This variable becomes TRUE when Driver READY turns on.                                                                                                                       |
| Busy            | Executing       | BOOL       | FALSE         | This variable becomes TRUE when MC_Power (Operation Available) is executed.                                                                                                  |
| Error           | Error           | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                             |
| ErrorID         | Error code      | WORD(UINT) | 0             | <p>When an error occurs, this variable returns the error code.</p> <p>For details on error codes, refer to the following.</p> <p>☞ User's manual for the controller used</p> |

## Processing details

- This FB initializes the information of the specified axis and switches the axis to the operation possible status.
- When the inputs for Enable (Enable) and Servo ON request (ServoON) are TRUE, the selected axis is switched to the operation possible status.
- Executing (Busy) becomes TRUE when the processing is started.
- Operable (Status) becomes TRUE when the drive unit has been switched to the operation possible status.
- When an error occurs in MC\_Power (Operation Available), Error (Error) becomes TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

 User's manual for the controller used

- Axis status (AxisName.Md.AxisStatus) of the AXIS\_MONI structure transits from "0: Axis disabled (Disabled)" to "4: Standby (Standstill)". For the axis state transition, refer to the following.

 User's manual for the controller used

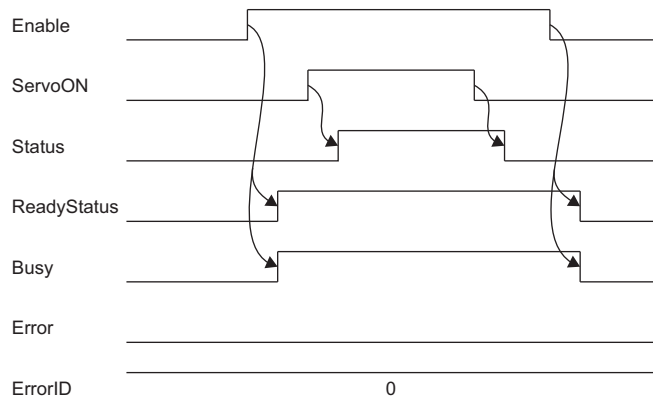
- Inputting Enable (Enable) and Servo ON request (ServoON) switches the servo ON/OFF status and the drive unit status of the axis as shown below.

| Input variable  |                            | Output variable               |                   | Servo ON/OFF status | Driver status<br>( <u>AxisName</u> .Md.Driver_State) |
|-----------------|----------------------------|-------------------------------|-------------------|---------------------|------------------------------------------------------|
| Enable (Enable) | Servo ON request (ServoON) | Ready ON status (ReadyStatus) | Operable (Status) |                     |                                                      |
| TRUE            | TRUE                       | TRUE                          | TRUE              | Servo ON            | 6: Operation Enable (OperationEnable)                |
|                 | FALSE                      | TRUE                          | FALSE             | Servo OFF           | 5: Switched On (SwitchedOn)                          |
| FALSE           | TRUE                       | FALSE                         | FALSE             | Servo OFF           | 3: Switched On Disabled (SwitchOnDisabled)           |
|                 | FALSE                      | FALSE                         | FALSE             | Servo OFF           | 3: Switched On Disabled (SwitchOnDisabled)           |

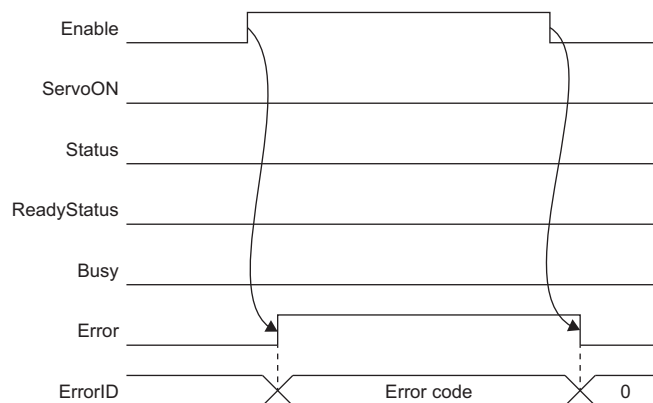
- If the real axis is rotated by external force during the servo OFF status, follow up processing is performed.
- The servo ON/OFF control can be operated regardless of the control mode. The control mode during servo OFF depends on the specifications of the drive unit.
- MC\_Power (Operation Available) is sent to the drive unit while a drive unit error is occurring, so Enable (Enable) and Servo ON request (ServoON) do not need to be turned from FALSE to TRUE again.

## ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error



## Precautions

- Axis No. (AxisNo) of the AXIS\_REF structure must be set in advance before MC\_Power (Operation Available) is executed.
- MC\_Power (Operation Available) establishes the axis information the first time that the FB is called after "PLC Ready (MotionSystem.Cd.SequenceReady)" is switched to on. Changes made to the axis information while Enable (Enable) is FALSE are not reflected.
- Do not set two or more MC\_Power (Operation Available) for one axis. The operation is not guaranteed if two or more of this FB are set.
- The servo ON/OFF status when stopping the program is maintained while Built-in motion ready (X420) is off.

## Program example

The following is a program example. The servo ON request command (bServoON) is set to TRUE, and Axis 1 (Axis0001) is switched to the operation possible status.

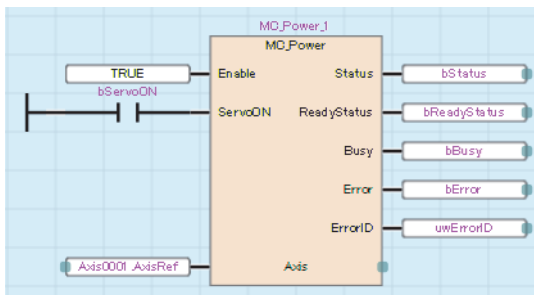
### ■Axis

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### ■Labels used

| Label name   | Data type                           | Comment                  |
|--------------|-------------------------------------|--------------------------|
| MC_Power_1   | MC_Power                            | Operation Available FB   |
| bServoON     | Bit                                 | Servo ON request command |
| bStatus      | Bit                                 | Operable                 |
| bReadyStatus | Bit                                 | Ready ON status          |
| bBusy        | Bit                                 | Executing                |
| bError       | Bit                                 | Error                    |
| uwErrorID    | Word [unsigned]/bit string [16-bit] | Error code               |

### ■FBD/LD program



### ■ST program

```
MC_Power_1(
  Axis:= Axis0001.AxisRef ,
  Enable:= TRUE ,
  ServoON:= bServoON ,
  Status=> bStatus ,
  ReadyStatus=> bReadyStatus ,
  Busy=> bBusy ,
  Error=> bError ,
  ErrorID=> uwErrorID
);
```

# 45.4 Current Position Change

## MC\_SetPosition

This FB changes the current position (commanded position, actual position) of the specified axis.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                                                                                                                          |
|----------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_SetPosition(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   Position:= ?LREAL? ,   Relative:= ?BOOL? ,   ExecutionMode:= ?INT? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   CancelAccepted=&gt; ?BOOL? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Setting range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —             | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable | Name                        | Data type               | Input    | Setting range                   | Default value | Description                                                                                                                                                                                                                                                                                                                      |
|----------------|-----------------------------|-------------------------|----------|---------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute        | Execution command           | BOOL                    | At start | TRUE, FALSE                     | FALSE         | When this variable is set to TRUE, MC_SetPosition (Current Position Change) is executed.                                                                                                                                                                                                                                         |
| Position       | Target position             | LREAL                   | At start | -10000000000.0 to 10000000000.0 | 0.0           | The change target position of the specified axis is set.<br>The setting value differs depending on the setting of Relative position selection (Relative).<br>For details, refer to the following.<br>Page 1542 Target position (Position)                                                                                        |
| Relative       | Relative position selection | BOOL                    | At start | TRUE, FALSE                     | FALSE         | Whether to change the current position with the relative distance or the absolute position is set.<br><ul style="list-style-type: none"> <li>FALSE: Current position change with the absolute position</li> <li>TRUE: Current position change with the relative distance</li> </ul>                                              |
| ExecutionMode  | Execution mode              | INT (MC_EXECUTION_MODE) | At start | 1, 3                            | 3             | The execution method of MC_SetPosition (Current Position Change) is set.<br><ul style="list-style-type: none"> <li>1: Execute at completion (mcQueued)*<sup>1</sup></li> <li>3: Execute speculatively (mcSpeculatively)*<sup>2</sup></li> </ul> For details, refer to the following.<br>Page 1543 Execution mode (ExecutionMode) |

| Input variable | Name    | Data type  | Input    | Setting range          | Default value | Description                                                                                                                                                                                                                                                         |
|----------------|---------|------------|----------|------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Options        | Options | DWORD(HEX) | At start | 00000000H to 00010000H | 00000000H     | The function options for MC_SetPosition (Current Position Change) are set in the specified bit position.<br>For details, refer to the following.<br> Page 1544 Options (Options) |

\*1 The FB is executed after the previous FB is completed.

\*2 The FB can be executed only when there is no running FB on the specified axis.

## ■Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                   |
|-----------------|-----------------------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when the current position change is completed.                                                                                                                                                                     |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MC_SetPosition (Current Position Change) is executed.                                                                                                                                                         |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_SetPosition (Current Position Change) is aborted.                                                                                                                                             |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                              |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |
| CancelAccepted  | Cancel acceptance     | BOOL       | FALSE         | This variable becomes TRUE when MC_SetPosition (Current Position Change) accepted the cancel.                                                                                                                                                 |

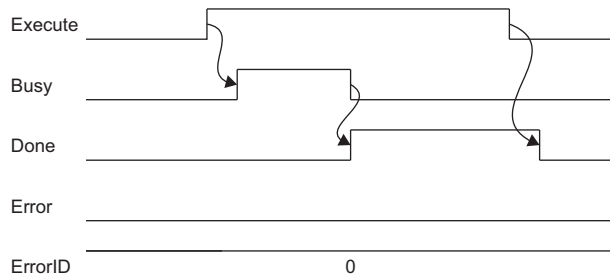
## Processing details

- This FB changes the current position of the specified axis.
- When Relative position selection (Relative) is TRUE, changes the current position to a position obtained by adding the target position (relative distance) to the current position.
- When Relative position selection (Relative) is FALSE, changes current position to the target position (absolute position).
- MC\_SetPosition (Current Position Change) is executed when Execution command (Execute) becomes TRUE, and Executing (Busy) becomes TRUE when the processing is started normally.
- When the processing is completed and the current position is changed, Execution completion (Done) becomes TRUE.
- When Axis status (AxisName.Md.AxisStatus) becomes "0: Axis disabled (Disabled)" or "1: Stopping on error (ErrorStop)" before the processing is completed after executing MC\_SetPosition (Current Position Change) with Execution mode (ExecutionMode) set to "1: Execute at completion (mcQueued)", MC\_SetPosition Instruction Error (error code: 1B9CH) occurs.
- When an error occurs in MC\_SetPosition (Current Position Change), Error (Error) becomes TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

 User's manual for the controller used

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

### ■Target position (Position)

The values that can be set in Target position (Position) differ depending on whether Relative position selection (Relative) is TRUE or FALSE.

Set Target position (Position) within the following setting range.

However, even when the position is within the specified range, an error occurs and the operation is not executed if the set position is outside the software stroke limit range after the current position change.

| Relative position selection (Relative)                 | Target position (Position) setting range                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FALSE (Current position change with absolute position) | <p>■When the ring counter is disabled<br/> <math>-10000000000.0 \leq \text{Setting value} &lt; 10000000000.0</math></p> <p>■When the ring counter is enabled<br/> <math>\text{Ring counter lower limit value} \leq \text{Setting value} &lt; \text{Ring counter upper limit value}</math></p>                                                                                              |
| TRUE (Current position change with relative distance)  | <p>■When the ring counter is disabled<br/> <math>-10000000000.0 \leq \text{Setting value} \leq 10000000000.0</math></p> <p>■When the ring counter is enabled<br/> <math>-(\text{Ring counter upper limit value} - \text{ring counter lower limit value}) / 2 \leq \text{Setting value} \leq (\text{Ring counter upper limit value} - \text{ring counter lower limit value}) / 2</math></p> |



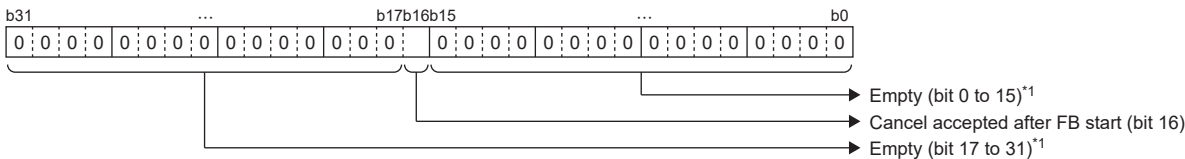
## ■ Execution mode (ExecutionMode)

When MC\_SetPosition (Current Position Change) is executed during axis operation, the timing for the change depends on the setting of Execution mode (ExecutionMode). The timing for Execution mode (ExecutionMode) is shown below.

| Setting value                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1: Execute at completion (mcQueued)        | <p>Executes after the FB being executed completes.</p> <p>At rising edge detection of Execution command (Execute), Executing (Busy) becomes TRUE and remains TRUE until Axis status (<u>AxisName</u>.Md.AxisStatus) changes to "4: Standby (Standstill)".</p> <p>Current position change operation is started when Axis status (<u>AxisName</u>.Md.AxisStatus) changes to "4: Standby (Standstill)".</p> <p>MC_MoveAbsolute</p> <ul style="list-style-type: none"> <li>Position: 100.0</li> <li>Done</li> <li>Busy</li> </ul> <p>AxisName.Md.AxisStatus: 5: DiscreteMotion, 4: Standstill</p> <p>MC_SetPosition</p> <ul style="list-style-type: none"> <li>Position: 190.0</li> <li>ExecutionMode: 1: mcQueued</li> <li>Relative</li> <li>Execute</li> <li>Done</li> <li>Busy</li> </ul> <p>Velocity</p> <p>Set position</p> <p>FB1 target address</p> <p>Address after changing the current position</p> |
| 3: Execute speculatively (mcSpeculatively) | <p>When Axis status (<u>AxisName</u>.Md.AxisStatus) of the relevant axis is "4: Standby (Standstill)" at rising edge detection of Execution command (Execute), the current position change can be executed.</p> <p>When Axis status (<u>AxisName</u>.Md.AxisStatus) of the relevant axis is not "4: Standby (Standstill)" or when an FB is being executed, MC_SetPosition Instruction Error (error code: 1B9CH) occurs and the current position change is not executed.</p> <p>AxisName.Md.AxisStatus: 4: Standstill</p> <p>MC_SetPosition</p> <ul style="list-style-type: none"> <li>Position: 190.0</li> <li>ExecutionMode: 3: mcSpeculatively</li> <li>Relative</li> <li>Execute</li> <li>Done</li> <li>Busy</li> </ul> <p>Set position</p> <p>Address after changing the current position</p>                                                                                                         |

■Options (Options)

The function options for MC\_SetPosition (Current Position Change) are set in the specified bit position.  
The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit | Name                           | Description                                                                                                                                                                          |
|-----|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16  | Cancel accepted after FB start | Sets whether or not to allow a cancel after MC_SetPosition (Current Position Change) is executed. <ul style="list-style-type: none"><li>• 0: Disabled</li><li>• 1: Enabled</li></ul> |

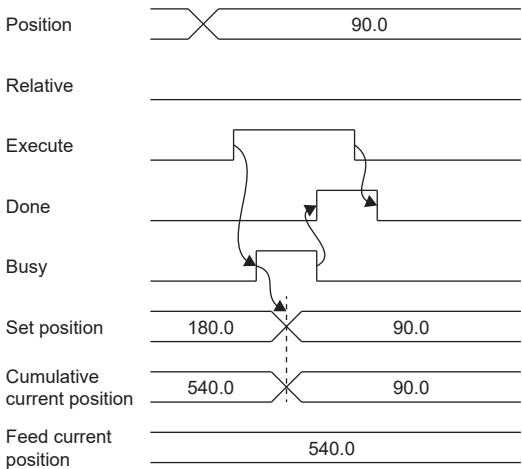
■Operation overview

When MC\_SetPosition (Current Position Change) is executed while the axis is stopped, the current position change operation starts at rising edge detection of Execution command (Execute). In the current position change, the set position and the cumulative current position are changed to the position set in Target position (Position). Target position (Position) becomes "Current position change with relative distance" when Relative position selection (Relative) is TRUE and "Current position change with absolute position" when Relative position selection (Relative) is FALSE.

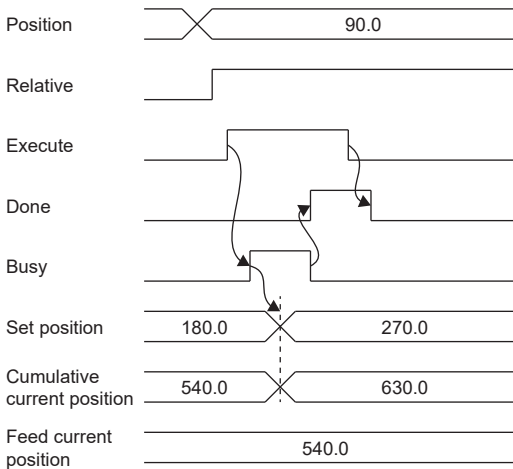
Ex.

When executing the current position change to "90.0" at a stop with a ring counter lower limit value of "0.0", a ring counter upper limit value of "360.0", and a set position of "180.0" (a cumulative current position of "540.0").

<When Relative position selection (Relative) is FALSE (absolute position)>



<When Relative position selection (Relative) is TRUE (relative distance)>



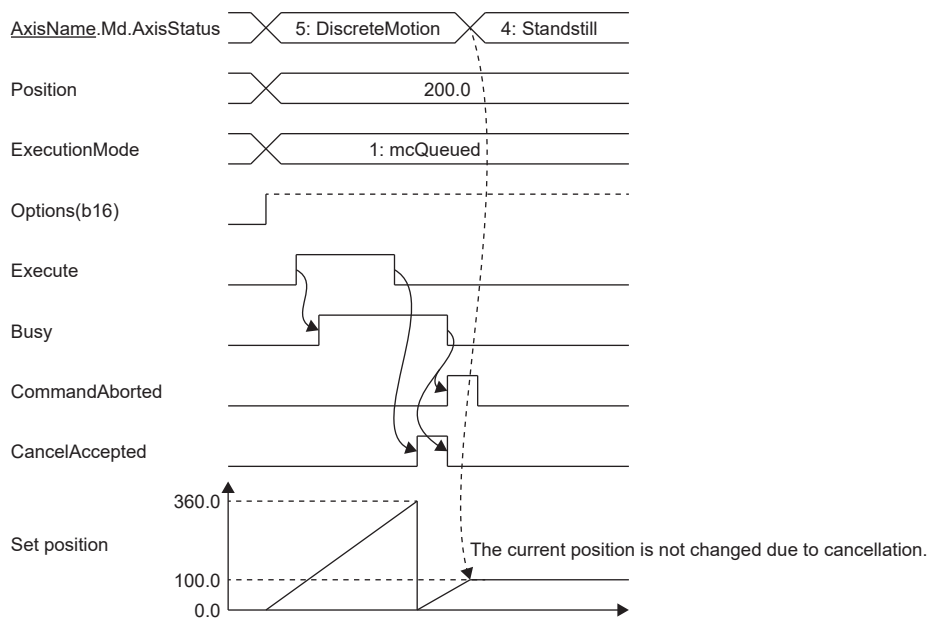
## ■Cancel

A current position change that is in the standby status can be canceled after MC\_SetPosition (Current Position Change) execution.

- To enable cancel, execute MC\_SetPosition (Current Position Change) with the status of "Cancel accepted after FB start (Options (Options): Bit 16)" set to "1: Allow".
- Cancel is started at falling edge detection of Execution command (Execute).
- Cancel is accepted only when Executing (Busy) of the output pin is TRUE.
- When MC\_SetPosition (Current Position Change) accepts the cancel, Cancel acceptance (CancelAccepted) of the output pin becomes TRUE.
- When cancel is completed, Abortion of execution (CommandAborted) of the output pin becomes TRUE.
- When cancelled, the set position is not changed.

### Ex.

After starting with Execution mode (ExecutionMode) set to "1: Execute at completion (mcQueued)", the change is cancelled while Axis Status (AxisName.Md.AxisStatus) is waiting to switch to "4: Standby (Standstill)"



## Precautions

Although the target position of the MC\_SetPosition (Current Position Change) being executed will not change if the current position is changed during axis operation, the operation to the target value will be changed because of the current position being changed.

## Program example

The following is a program example. The current position change command (bSetPosition) is set to TRUE, and the current position of Axis 1 (Axis0001) is changed to "100.0".

### ■Axis

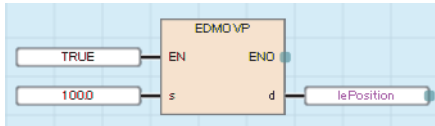
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### ■Labels used

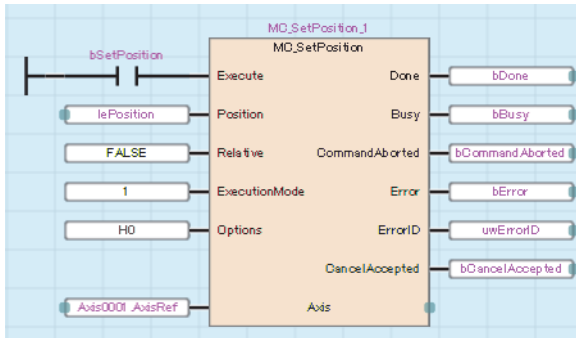
| Label name       | Data type                           | Comment                         |
|------------------|-------------------------------------|---------------------------------|
| MC_SetPosition_1 | MC_SetPosition                      | Current Position Change FB      |
| bSetPosition     | Bit                                 | Current position change command |
| lePosition       | Double-precision real number        | Target position                 |
| bDone            | Bit                                 | Ready                           |
| bBusy            | Bit                                 | Executing                       |
| bCommandAborted  | Bit                                 | Abortion of execution           |
| bError           | Bit                                 | Error                           |
| uwErrorID        | Word [unsigned]/bit string [16-bit] | Error code                      |
| bCancelAccepted  | Bit                                 | Cancel acceptance               |

## ■FBD/LD program

- Data setting for Current Position Change



- Current Position Change



## ■ST program

//-----Data setting for Current Position Change-----

lePosition:= 100.0;

//-----Current Position Change-----

```
MC_SetPosition_1(
  Axis:= Axis0001.AxisRef ,
  Execute:= bSetPosition ,
  Position:= lePosition ,
  Relative:= FALSE ,
  ExecutionMode:= MC_EXECUTION_MODE__mcQueued ,
  Options:= H00000000 ,
  Done=> bDone ,
  Busy=> bBusy ,
  CommandAborted=> bCommandAborted ,
  Error=> bError ,
  ErrorID=> uwErrorID ,
  CancelAccepted=> bCancelAccepted
);
```

# 45.5 Torque Limit Value

## MCv\_SetTorqueLimit

This FB changes a torque limit value.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MCv_SetTorqueLimit(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   PositiveValid:= ?BOOL? ,   PositiveValue:= ?LREAL? ,   NegativeValid:= ?BOOL? ,   NegativeValue:= ?LREAL? ,   ExecutionMode:= ?INT? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   CancelAccepted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Setting range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —             | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable | Name                                  | Data type               | Input                        | Setting range     | Default value | Description                                                                                                                                                                                                                                                                                      |
|----------------|---------------------------------------|-------------------------|------------------------------|-------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute        | Execution command                     | BOOL                    | At start                     | TRUE, FALSE       | FALSE         | When this variable is set to TRUE, MCv_SetTorqueLimit (Torque Limit Value) is executed.                                                                                                                                                                                                          |
| PositiveValid  | Positive direction torque limit valid | BOOL                    | At start/ Retrigger possible | TRUE, FALSE       | FALSE         | Whether to enable or disable the positive direction torque limit setting value change is set.<br>• FALSE: Positive direction torque limit disabled<br>• TRUE: Positive direction torque limit enabled                                                                                            |
| PositiveValue  | Positive direction torque limit value | LREAL                   | At start/ Retrigger possible | 0.0 to 1000.0 [%] | 0.0           | The positive direction torque limit value is set.<br>The value is imported when Positive direction torque limit valid (PositiveValid) is TRUE.                                                                                                                                                   |
| NegativeValid  | Negative direction torque limit valid | BOOL                    | At start/ Retrigger possible | TRUE, FALSE       | FALSE         | Whether to enable or disable the negative direction torque limit setting value change is set.<br>• FALSE: Negative direction torque limit disabled<br>• TRUE: Negative direction torque limit enabled                                                                                            |
| NegativeValue  | Negative direction torque limit value | LREAL                   | At start/ Retrigger possible | 0.0 to 1000.0 [%] | 0.0           | The negative direction torque limit value is set.<br>The value is imported when Negative direction torque limit valid (NegativeValid) is TRUE.                                                                                                                                                   |
| ExecutionMode  | Execution mode                        | INT (MC_EXECUTION_MODE) | At start                     | 0, 1, 3           | 0             | The execution timing of MCv_SetTorqueLimit (Torque Limit Value) is set.<br>• 0: Execute immediately (mcImmediately)<br>• 1: Execute at completion (mcQueued)<br>• 3: Execute speculatively (mcSpeculatively)<br>For details, refer to the following.<br>Page 1551 Execution mode (ExecutionMode) |

| Input variable | Name    | Data type  | Input    | Setting range          | Default value | Description                                                                                                                                                                                                                                                        |
|----------------|---------|------------|----------|------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Options        | Options | DWORD(HEX) | At start | 00000000H to 00010000H | 00000000H     | The function options for MCv_SetTorqueLimit (Torque Limit Value) are set in the specified bit position.<br>For details, refer to the following.<br> Page 1551 Options (Options) |

## ■Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                   |
|-----------------|-----------------------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when the torque limit value change is completed successfully.                                                                                                                                                      |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MCv_SetTorqueLimit (Torque Limit Value) is executed.                                                                                                                                                          |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MCv_SetTorqueLimit (Torque Limit Value) is aborted.                                                                                                                                              |
| CancelAccepted  | Cancel acceptance     | BOOL       | FALSE         | This variable becomes TRUE when MCv_SetTorqueLimit (Torque Limit Value) accepts the cancel.                                                                                                                                                   |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                              |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |

## Processing details

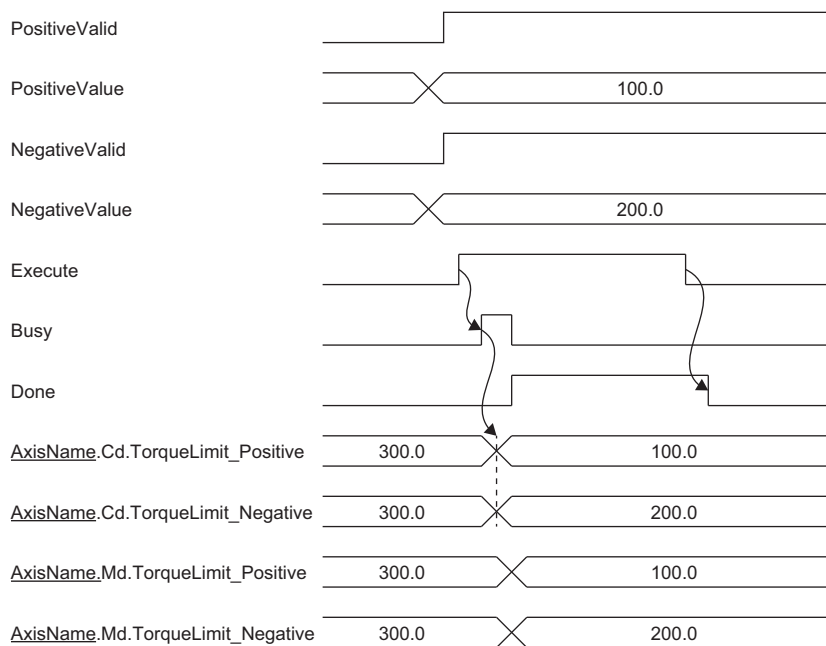
- This FB changes a positive direction torque limit value or negative direction torque limit value.
- When Positive direction torque limit valid (PositiveValid) is TRUE, a positive direction torque limit value is changed to the value of Positive direction torque limit value (PositiveValue).
- When Negative direction torque limit valid (NegativeValid) is TRUE, a negative direction torque limit value is changed to the value of Negative direction torque limit value (NegativeValue).
- MCv\_SetTorqueLimit (Torque Limit Value) is executed when Execution command (Execute) is TRUE, and Executing (Busy) becomes TRUE when the processing starts normally.
- The timing for the torque limit change is set in Execution mode (ExecutionMode).
- When the processing is completed and the torque limit value is changed, Execution completion (Done) becomes TRUE.
- After starting MCv\_SetTorqueLimit (Torque Limit Value) with Execution mode (ExecutionMode) set to "1: Execute at completion (mcQueued)", if Axis status (AxisName.Md.AxisStatus) becomes "0: Axis disabled (Disabled)" or "1: Stopping on error (ErrorStop)" before the processing is completed, the processing is aborted and Abortion of execution (CommandAborted) becomes TRUE.
- When an error occurs in MCv\_SetTorqueLimit (Torque Limit Value), Error (Error) becomes TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

 User's manual for the controller used

- When Positive direction torque limit valid (PositiveValid) and Negative direction torque limit valid (NegativeValid) are both FALSE, the torque limit change is not performed and Execution completion (Done) becomes TRUE.

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

 Page 1432 Basic operation of Execution command (Execute) type motion control FBs



## ■ Execution mode (ExecutionMode)

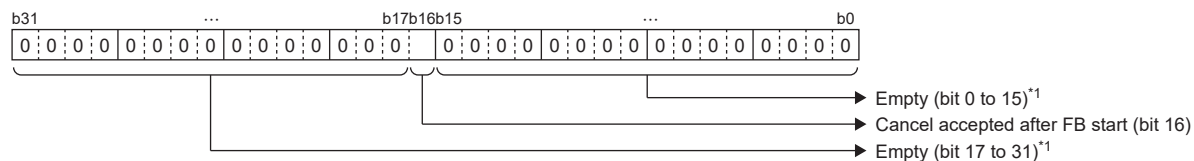
When executing MCv\_SetTorqueLimit (Torque Limit Value) during axis operation, the timing of the change depends on the setting of Execution mode (ExecutionMode). The timing for Execution mode (ExecutionMode) is shown below.

| Setting value                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Execute immediately (mcImmediately)     | Executes immediately regardless of Axis status ( <u>AxisName</u> .Md.AxisStatus). Positive direction torque limit value ( <u>AxisName</u> .Cd.TorqueLimit_Positive) and Negative direction torque limit value ( <u>AxisName</u> .Cd.TorqueLimit_Negative) are changed at rising edge detection of Execution command (Execute).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 3: Execute speculatively (mcSpeculatively) | <p>When Axis status (<u>AxisName</u>.Md.AxisStatus) of the relevant axis is "4: Standby (Standstill)" at rising edge detection of Execution command (Execute), the torque limit value change is executed.</p> <p>When Axis status (<u>AxisName</u>.Md.AxisStatus) of the relevant axis is not "4: Standby (Standstill)" or when an FB is being executed, MCv_SetTorqueLimit Instruction Error (error code: 1B9EH) occurs and the torque limit value change is not executed.</p> <p>The diagram illustrates the timing for Execution mode 3: mcSpeculatively. It shows the relationship between the Axis status (<u>AxisName</u>.Md.AxisStatus), the Execution mode (<u>AxisName</u>.Cd.ExecutionMode), the Execute command, the Busy signal, the Done signal, and the torque limit values (<u>AxisName</u>.Cd.TorqueLimit_Positive and <u>AxisName</u>.Cd.TorqueLimit_Negative). The Axis status is set to 4: Standstill. The Execution mode is set to 3: mcSpeculatively. The Execute command is triggered, and the Busy signal becomes active (low) after a delay. The Done signal becomes active (low) after a further delay. The torque limit values are updated at the rising edge of the Execute command, provided the axis is in Standby.</p> |

## ■ Options (Options)

The function options for MCv\_SetTorqueLimit (Torque Limit Value) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.

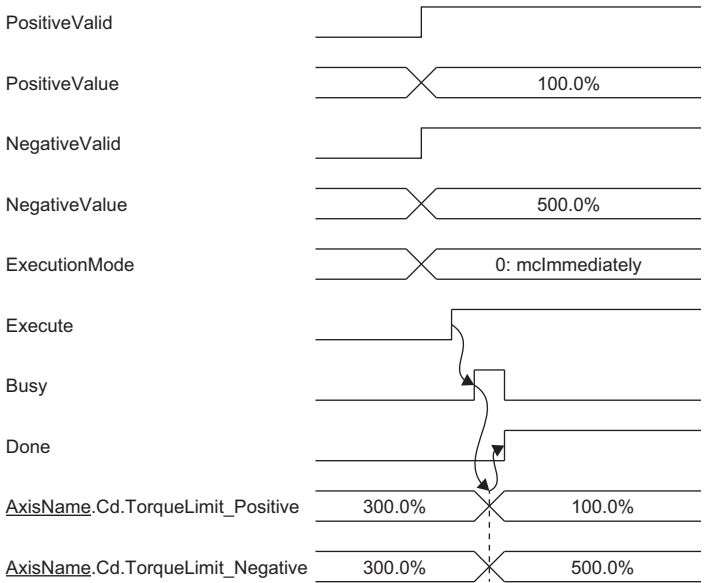


\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

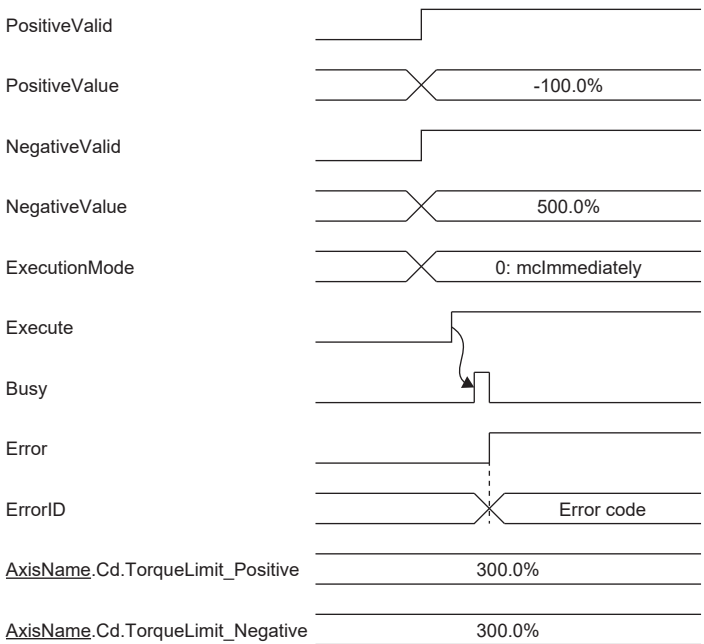
| Bit | Name                           | Description                                                                                                                                                                               |
|-----|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16  | Cancel accepted after FB start | <p>Sets whether or not to allow a cancel after MCv_SetTorqueLimit (Torque Limit Value) is executed.</p> <ul style="list-style-type: none"> <li>0: Disabled</li> <li>1: Enabled</li> </ul> |

■Operation overview

- In MCv\_SetTorqueLimit (Torque Limit Value), Positive direction torque limit value (AxisName.Cd.TorqueLimit\_Positive) and Negative direction torque limit value (AxisName.Cd.TorqueLimit\_Negative) are changed.



- If Execution command (Execute) is set to TRUE while a value outside the range is set in Positive direction torque limit value (PositiveValue) or Negative direction torque limit value (NegativeValue), an error occurs in MCv\_SetTorqueLimit (Torque Limit Value) and Positive direction torque limit value (AxisName.Cd.TorqueLimit\_Positive) and Negative direction torque limit value (AxisName.Cd.TorqueLimit\_Negative) will not be changed.



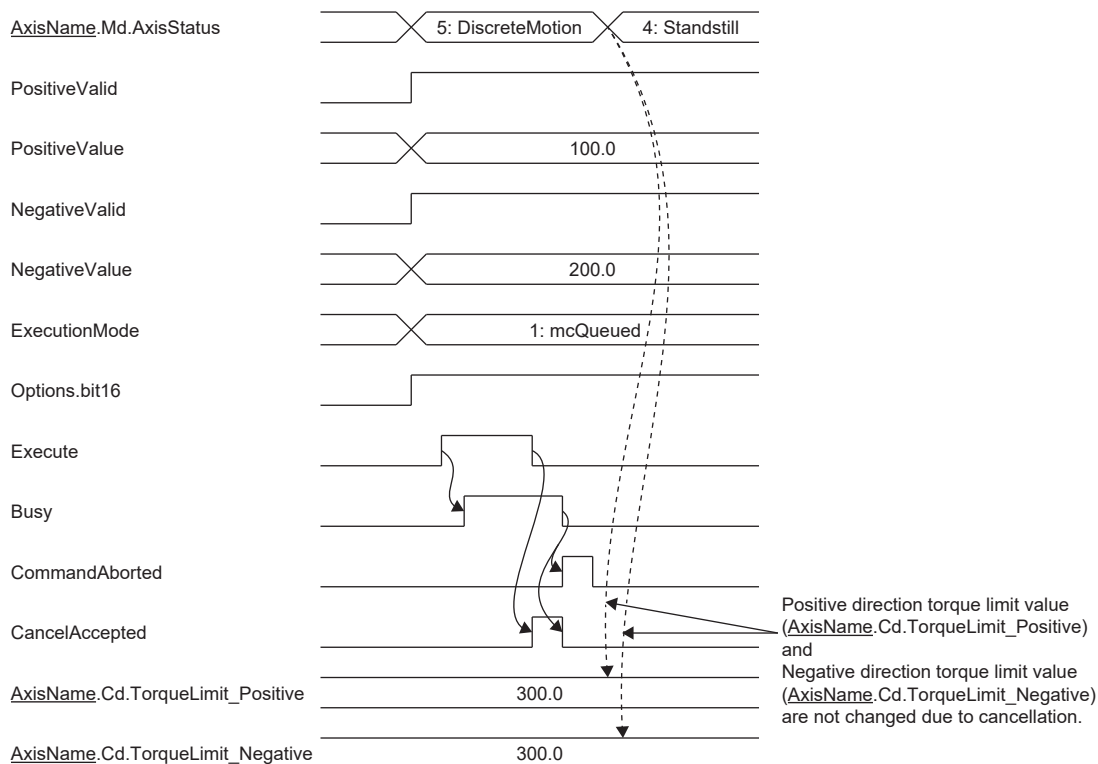
## ■Cancel

A torque limit value change that is in the standby status can be canceled after MCv\_SetTorqueLimit (Torque Limit Value) execution.

- To enable cancel, execute MCv\_SetTorqueLimit (Torque Limit Value) with the status of "Cancel accepted after FB start (Options (Options): Bit 16)" set to "1: Allow".
- Cancel is started at falling edge detection of Execution command (Execute).
- Cancel is accepted only when Executing (Busy) of the output pin is TRUE.
- When MCv\_SetTorqueLimit (Torque Limit Value) accepts the cancel, Cancel acceptance (CancelAccepted) of the output pin becomes TRUE.
- When cancel is completed, Abortion of execution (CommandAborted) of the output pin becomes TRUE.
- When cancelled, Positive direction torque limit value (AxisName.Cd.TorqueLimit\_Positive) and Negative direction torque limit value (AxisName.Cd.TorqueLimit\_Negative) will not be changed.

### Ex.

After starting with Execution mode (ExecutionMode) set to "1: Execute at completion (mcQueued)", the change is cancelled while Axis Status (AxisName.Md.AxisStatus) is waiting to switch to "4: Standby (Standstill)"



## Precautions

In MCv\_SetTorqueLimit (Torque Limit Value), changing of Positive direction torque limit value (AxisName.Cd.TorqueLimit\_Positive) and Negative direction torque limit value (AxisName.Cd.TorqueLimit\_Negative) is performed.

## Program example

The following is a program example. The torque limit value change command (bSetTorqueLimit) is set to TRUE, and the positive direction torque limit value for Axis 1 (Axis0001) is changed to "100.0" and the negative direction torque limit value for Axis 1 (Axis0001) is changed to "200.0".

### Axis

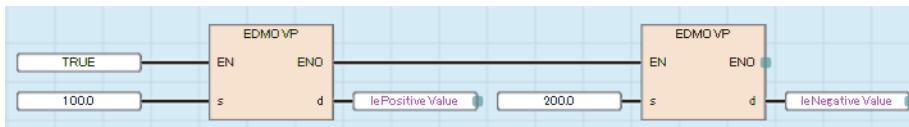
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### Labels used

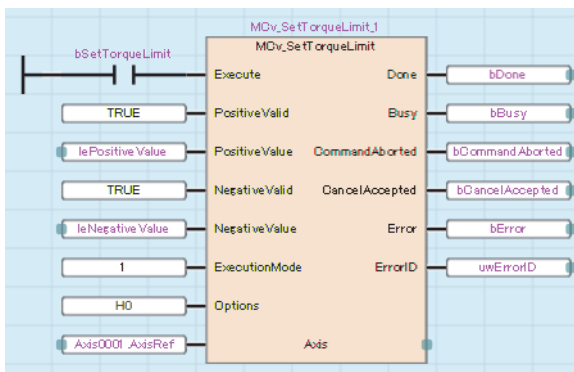
| Label name           | Data type                           | Comment                               |
|----------------------|-------------------------------------|---------------------------------------|
| MCv_SetTorqueLimit_1 | MCv_SetTorqueLimit                  | Torque Limit Value FB                 |
| bSetTorqueLimit      | Bit                                 | Torque limit value change command     |
| lePositiveValue      | Double-precision real number        | Positive direction torque limit value |
| leNegativeValue      | Double-precision real number        | Negative direction torque limit value |
| bDone                | Bit                                 | Ready                                 |
| bBusy                | Bit                                 | Executing                             |
| bCommandAborted      | Bit                                 | Abortion of execution                 |
| bCancelAccepted      | Bit                                 | Cancel acceptance                     |
| bError               | Bit                                 | Error                                 |
| uwErrorID            | Word [unsigned]/bit string [16-bit] | Error code                            |

### FBD/LD program

- Data setting for torque limit value change



- Torque limit value change



## ■ST program

//-----Data setting for torque limit value change-----

lePositiveValue:= 100.0;

leNegativeValue:= 200.0;

//-----Torque limit value change-----

MCv\_SetTorqueLimit\_1(

Axis:= Axis0001.AxisRef ,

Execute:= bSetTorqueLimit ,

PositiveValid:= TRUE ,

PositiveValue:= lePositiveValue ,

NegativeValid:= TRUE ,

NegativeValue:= leNegativeValue ,

ExecutionMode:= MC\_EXECUTION\_MODE\_\_mcQueued ,

Options:= H00000000 ,

Done=> bDone ,

Busy=> bBusy ,

CommandAborted=> bCommandAborted ,

CancelAccepted=> bCancelAccepted ,

Error=> bError ,

ErrorID=> uwErrorID

);

# 45.6 Override Value Setting

## MC\_SetOverride

This FB changes the target velocity, the target acceleration, and the target deceleration of the specified axis.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                                          |
|----------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_SetOverride(   Axis:= ?AXIS_REF? ,   Enable:= ?BOOL? ,   VelFactor:= ?LREAL? ,   AccFactor:= ?LREAL? ,   JerkFactor:= ?LREAL? ,   Enabled=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Setting range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —             | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable | Name                         | Data type | Input  | Setting range       | Default value | Description                                                                                                                                                                                                                          |
|----------------|------------------------------|-----------|--------|---------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable         | Enable                       | BOOL      | Always | TRUE, FALSE         | FALSE         | When this variable is set to TRUE, MC_SetOverride (Override Value Setting) is executed.                                                                                                                                              |
| VelFactor      | Velocity override factor     | LREAL     | Always | 0.00 to 10.00       | 0.00          | The velocity override factor is set.<br>When Enable (Enable) is TRUE, the value is always imported.                                                                                                                                  |
| AccFactor      | Acceleration override factor | LREAL     | Always | 0.00, 0.01 to 10.00 | 0.00          | The acceleration override factor is set.<br>When Enable (Enable) is TRUE, the value is always imported.<br>When "0.00" is set, the acceleration override factor is not changed and the control is performed with the previous value. |
| JerkFactor     | Jerk override factor         | LREAL     | Always | 0.0                 | 0.0           | "0.0" must be set.<br>* If a value other than "0.0" is set, Out of Jerk Override Coefficient (JerkFactor) Range (error code: 1BBEH) occurs.                                                                                          |

#### Output variables

| Output variable | Name       | Data type  | Default value | Description                                                                                                                                                 |
|-----------------|------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enabled         | Enabled    | BOOL       | FALSE         | This variable becomes TRUE when the override values are set correctly.                                                                                      |
| Busy            | Executing  | BOOL       | FALSE         | This variable becomes TRUE when MC_SetOverride (Override Value Setting) is executed.                                                                        |
| Error           | Error      | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                            |
| ErrorID         | Error code | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used |

## Processing details

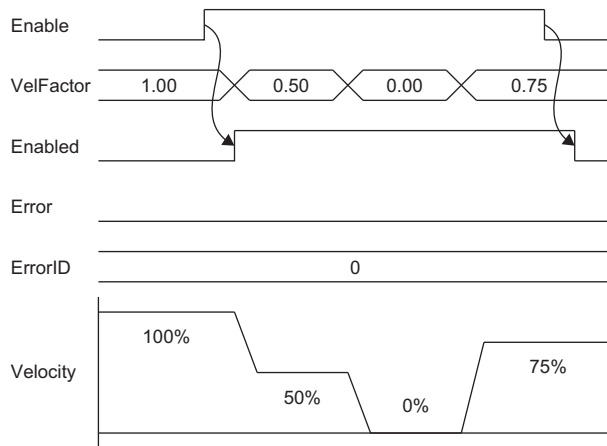
- This FB changes the target velocity, the target acceleration, and the target deceleration of the specified axis.
- The current operating target velocity, target acceleration, and target deceleration values are changed by multiplying each value by the override factor.
- MC\_SetOverride (Override Value Setting) is executed when Enable (Enable) becomes TRUE. Enabled (Enabled) becomes TRUE while the override factor is valid.
- If the override factor value is changed while Enable (Enable) is TRUE, the new override factor is reflected.
- When an error occurs in MC\_SetOverride (Override Value Setting), Error (Error) becomes TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

 User's manual for the controller used

- When the value for Velocity override factor (VelFactor) is set to "0.00", the axis stops without Axis status (AxisName.Md.AxisStatus) changing to "4: Standby (Standstill)".
- When the value for Acceleration override factor (AccFactor) is set to "0.00", the acceleration override factor is not changed and the previous acceleration override factor is maintained.

### ■Timing chart

- When the processing is completed successfully



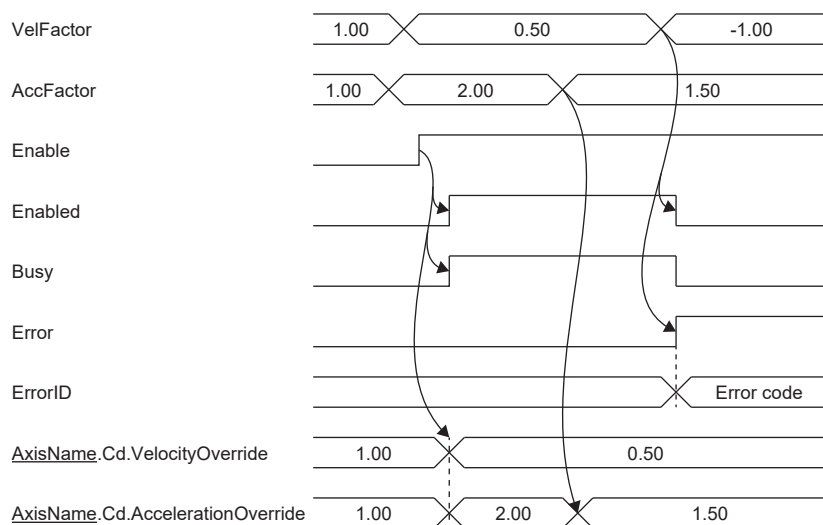
- When the processing is completed with an error

For the timing chart, refer to the following.

 Page 1435 Basic operation of Enable (Enable) type motion control FBs

## ■ Operation overview

- In MC\_SetOverride (Override Value Setting), Velocity override factor (AxisName.Cd.VelocityOverride) and Acceleration override factor (AxisName.Cd.AccelerationOverride) are changed.



- If a value outside the range is set as the override factor, an error occurs in MC\_SetOverride (Override Value Setting) and subsequent values will not be imported. To import values again, restart Enable (Enable).

## Precautions

- Do not arrange two or more MC\_SetOverride (Override Value Setting) in the same axis. The operation is not guaranteed if two or more of this FB are set.
- In single axis control, only the override factor set with the axis control data has an effect.
- Do not operate Velocity override factor (AxisName.Cd.VelocityOverride) or Acceleration override factor (AxisName.Cd.AccelerationOverride) directly while executing MC\_SetOverride (Override Value Setting).
- When the speed after Speed override is out of range, refer to "Velocity Range" in the following.

User's manual for the controller used

- When the acceleration, deceleration, acceleration time, and deceleration time after acceleration override is out of range, refer to "Acceleration/deceleration processing function" in the following.

User's manual for the controller used



## Program example

The following is a program example. The override value change command (bSetOverride) is set to TRUE, and the target velocity, target acceleration, and target deceleration of Axis 1 (Axis0001) are changed to values multiplied by a velocity override factor of "1.0" and an acceleration/deceleration override factor of "2.0".

### Axis

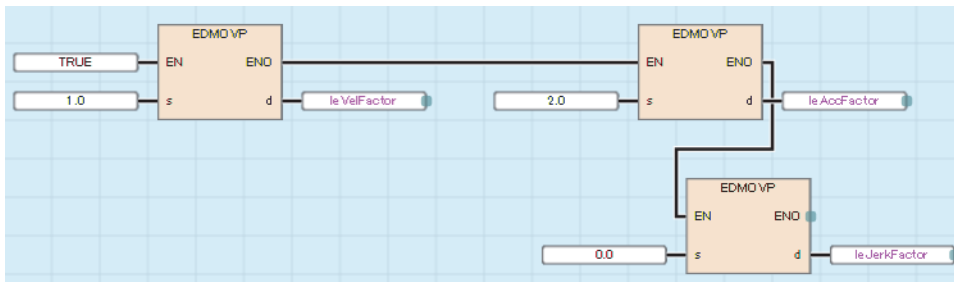
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### Labels used

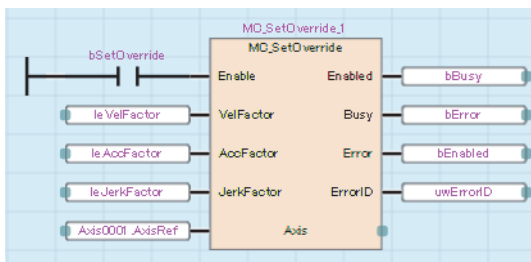
| Label name       | Data type                           | Comment                                   |
|------------------|-------------------------------------|-------------------------------------------|
| MC_SetOverride_1 | MC_SetOverride                      | Override Value Setting FB                 |
| bSetOverride     | Bit                                 | Override value change command             |
| leVelFactor      | Double-precision real number        | Velocity override factor                  |
| leAccFactor      | Double-precision real number        | Acceleration/deceleration override factor |
| leJerkFactor     | Double-precision real number        | Jerk override factor                      |
| bEnabled         | Bit                                 | Enabled                                   |
| bBusy            | Bit                                 | Executing                                 |
| bError           | Bit                                 | Error                                     |
| uwErrorID        | Word [unsigned]/bit string [16-bit] | Error code                                |

### FBD/LD program

- Data setting for override value change



- Override value change



## ■ST program

//-----Data setting for override value change-----

leVelFactor:= 1.00;

leAccFactor:= 2.00;

leJerkFactor:= 0.0;

//-----Override value change-----

MC\_SetOverride\_1(

Axis:= Axis0001.AxisRef ,

Enable:= bSetOverride ,

VelFactor:= leVelFactor ,

AccFactor:= leAccFactor ,

JerkFactor:= leJerkFactor ,

Enabled=> bEnabled ,

Busy=> bBusy ,

Error=> bError ,

ErrorID=> uwErrorID

);

# 45.7 Parameter Read

45

## MC\_ReadParameter

This FB reads objects of a device station.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                     |
|----------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_ReadParameter(   Axis:= ?AXIS_REF? ,   Enable:= ?BOOL? ,   ParameterNumber:= ?DWORD? ,   ReadCount:= ?WORD? ,   Options:= ?DWORD? ,   Valid=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   SDOErrorID=&gt; ?DWORD? ,   Value=&gt; ?LREAL? ,   SDOStatus=&gt; ?WORD? ,   ReadCounter=&gt; ?WORD? ); </pre> |

### Setting data

#### ■ I/O variables

| I/O variable | Name             | Data type | Input    | Setting range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —             | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### ■ Input variable

| Input variable  | Name                    | Data type  | Input    | Setting range          | Default value | Description                                                                                                                                                                                                                          |
|-----------------|-------------------------|------------|----------|------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable          | Enable                  | BOOL       | At start | TRUE, FALSE            | FALSE         | When this variable is set to TRUE, MC_ReadParameter (Parameter Read) is executed.                                                                                                                                                    |
| ParameterNumber | Parameter No.           | DWORD(HEX) | Always   | 00010000H to FFFFFFFFH | 00000000H     | The object of a device station is set.<br>For details, refer to the following.<br>Page 1564 Parameter No. (ParameterNumber)                                                                                                          |
| ReadCount       | Number of reading times | WORD(UNIT) | Always   | 0 to 65535             | 0             | The number of parameter reading times is set.<br>When "0" is set, the parameter is continuously read until Enable (Enable) is set to FALSE.<br>Reimport is performed when the parameter No. is changed.                              |
| Options         | Options                 | DWORD(HEX) | Always   | 00000000H to 00010000H | 00000000H     | The function options for MC_ReadParameter (Parameter Read) are set in the specified bit position.<br>Reimport is performed when the parameter No. is changed.<br>For details, refer to the following.<br>Page 1564 Options (Options) |

## Output variables

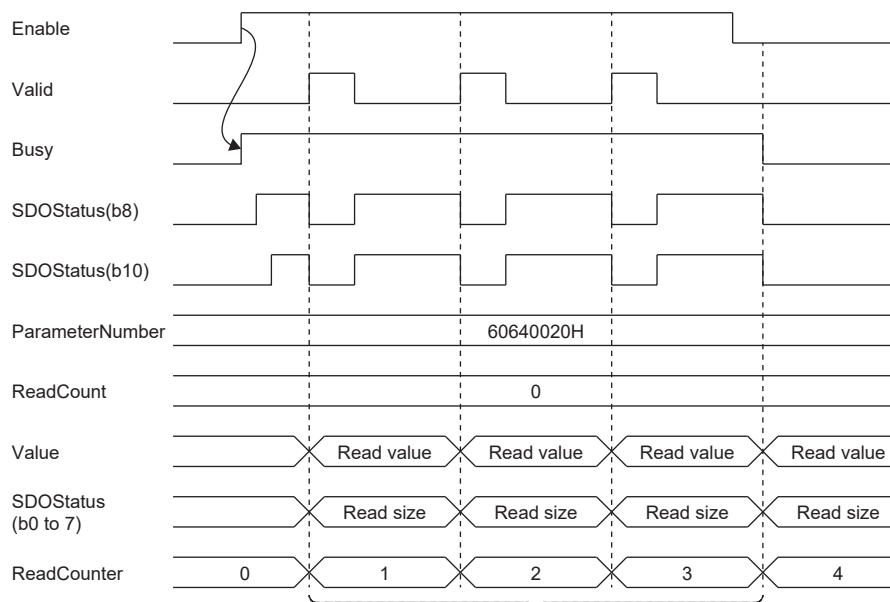
| Output variable | Name                    | Data type  | Default value | Description                                                                                                                                                                                                                                   |
|-----------------|-------------------------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Valid           | Output value valid      | BOOL       | FALSE         | This variable becomes TRUE when the output value is valid.                                                                                                                                                                                    |
| Busy            | Executing               | BOOL       | FALSE         | This variable becomes TRUE when MC_ReadParameter (Parameter Read) is executed.                                                                                                                                                                |
| Error           | Error                   | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                              |
| ErrorID         | Error code              | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |
| SDOErrorID      | Transient error code    | DWORD(HEX) | 00000000H     | When an error occurs in SDO communication, this variable returns the response code (SDO Abort Code).                                                                                                                                          |
| Value           | Read value              | LREAL      | 0.0           | This variable outputs the value read from the specified parameter.<br>The value is stored as LREAL type even when the target parameter data is integer.                                                                                       |
| SDOStatus       | SDO transfer status     | WORD(UINT) | 0             | This variable stores the processing status of the transient request.<br>For details, refer to the following.<br> Page 1564 SDO transfer status (SDOStatus)   |
| ReadCounter     | Number of reading times | WORD(UINT) | 0             | This variable stores the number of parameter reading times.<br>When "0" is set to Number of reading times (ReadCount), the variable works as a ring counter of "0 to 65535".                                                                  |

## Processing details

- This FB reads object data by setting a value 00010000H or greater in Parameter No. (ParameterNumber). In this case, the object data is sent/received using the transient transmission function.
- When a transient request error (response code (SDO Abort Code)) is received from the device, Error (Error) becomes TRUE, SDO Communication Error (error code: 1A48H) is stored in Error code (ErrorID), and the response code (SDO Abort Code) from the device is stored in Transient error code (SDOErrorID).

## Timing chart

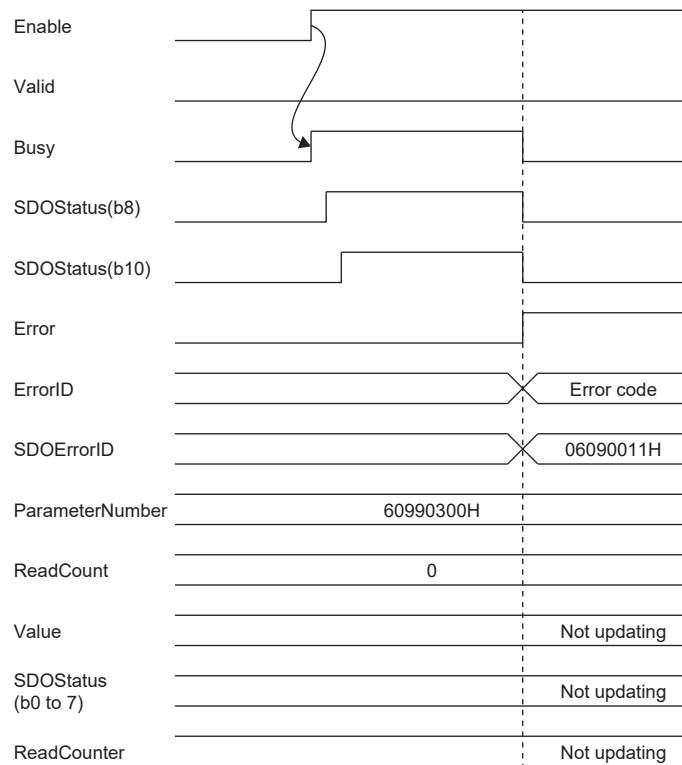
- When the processing is completed successfully



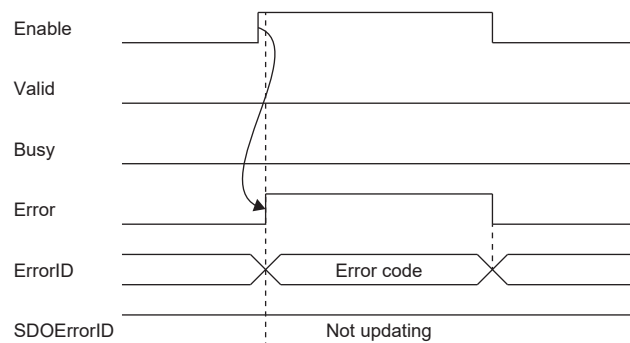
Reading is performed for the number of times set in the number of reads (ReadCount) until Enable becomes FALSE.  
(When the number of reads (ReadCount) is "0", reading is continuously performed until Enable becomes FALSE.)

- When the processing is completed with an error

- SDO communication error



- I/O variable or input variable error

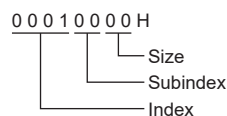


## ■Parameter No. (ParameterNumber)

- The classification of Parameter No. (ParameterNumber) set when reading parameters is shown below.

| Parameter No.          | Description                       |
|------------------------|-----------------------------------|
| 00010000H to FFFFFFFFH | The object of the device station. |

- The contents of Parameter No. (ParameterNumber) when setting the object of the device station are shown below.



- When setting the size of the objects of the device station, specify 1 byte (08H)/ 2 bytes (10H)/ 4 bytes (20H)/ 8 bytes (40H) in bits. If "00H" is specified, the parameter read is performed with default size. If a value other than the above setting values is specified, Out of Parameter No. Range (error code: 1BC2H) occurs.
- When the size specified with Parameter No. (ParameterNumber) differs from default size of the object data, the operations depend on the specifications of the drive unit.

### Ex.

When setting object index "6099H", UNSIGNED32 object of subindex "02H", and a size of "00H".  
Set "60990200H".

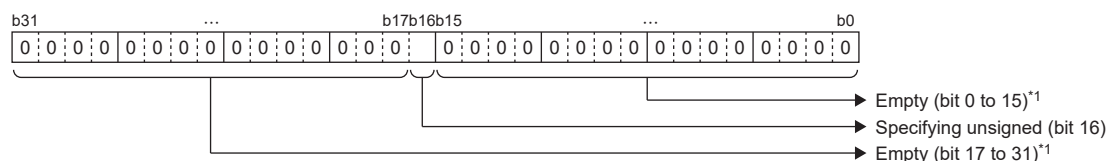
### Point

For the objects of each device station, refer to the device station manual.

## ■Options (Options)

The function options for MC\_ReadParameter (Parameter Read) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.

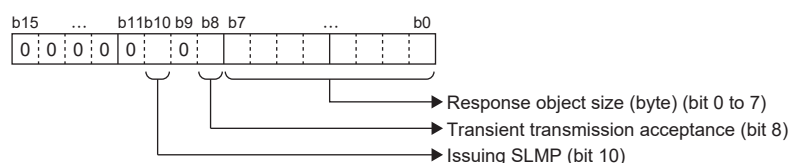


\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit | Name               | Description                                                                                                      |
|-----|--------------------|------------------------------------------------------------------------------------------------------------------|
| 16  | Specifies unsigned | Sets whether to store the read value of the integer data with or without a sign.<br>• 0: Signed<br>• 1: Unsigned |

## ■SDO transfer status (SDOStatus)

This variable stores the processing status of the transient request.



| Bit    | Name                                  | Description                                                                                                                  |
|--------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| 0 to 7 | Response object size (byte)           | Stores the object size sent by the device stations when the processing is completed.                                         |
| 8      | The transient transmission acceptance | Stores the transient transmission status.<br>• 0: Unexecuted transient transmission<br>• 1: Accepting transient transmission |
| 10     | Issuing SLMP                          | Stores the SLMP status.<br>• 0: Unexecuted SLMP<br>• 1: Issuing SLMP                                                         |

## Precautions

- Up to four transient transmissions can be executed toward the same axis. If MC\_ReadParameter (Parameter Read) is executed for object data towards an axis which is already executing four transient transmissions, Parameter Reading And Writing FB Execution Disabled Error (error code: 1BC1H) occurs and the next FB is not executed. However, the FB being executed continues.
- For the driver homing method, home position data of the drive unit is obtained using the transient transmission function. Therefore, if a parameter read for object data is executed when MC\_Home (OPR) is being executed, ABS Reference Point Read Error (error code: 1AF9H) may occur in MC\_Home (OPR).
- When reading the integer type/BOOL type parameters or object data, the value read with MC\_ReadParameter (Parameter Read) is converted into an LREAL type or BOOL type and output.

### Ex.

Reading parameters while specifying two bytes size in MC\_ReadParameter (Parameter Read).

| Parameter value | Read value (Value) (Data type: LREAL)                         |                                                                 |
|-----------------|---------------------------------------------------------------|-----------------------------------------------------------------|
|                 | Specifies unsigned (Options (Options): Bit 16)<br>"0: Signed" | Specifies unsigned (Options (Options): Bit 16)<br>"1: Unsigned" |
| 10000           | 10000.0                                                       | 10000.0                                                         |
| -20000          | -20000.0                                                      | 45536.0                                                         |
| 65535           | -1.0                                                          | 65535.0                                                         |
| 63356           | 0.0                                                           | 0.0                                                             |
| 131701          | -1.0                                                          | 65535.0                                                         |

- Values changed with MC\_ReadParameter (Parameter Read) are not saved. To use the changed values at the next power supply, save the parameters.  
For how to save parameters of objects of device stations, refer to the manual for the device stations.
- When devices in transient transmission are disconnected, all the transient requests for disconnected devices fail, and SDO Communication Error (error code: 1A48H) occurs.
- Before executing MC\_ReadParameter (Parameter Read), ensure that Driver status (AxisName.Md.Driver\_State) is not set to "-1: Axis variable not initialized/axis parameter error (Invalid)" or "0: Not Ready To Switch On (NotReadyToSwitchOn)". If executed in a status other than the above, Parameter Reading And Writing FB Execution Disabled Error (error code: 1BC1H) will occur.

## Program example

The following is a program example. The parameter read command (bReadParameter) is set to TRUE, and the values in the objects (index "6099H", subindex "02H", and size "00H") of Axis1 (Axis0001) are read.

### ■Axis

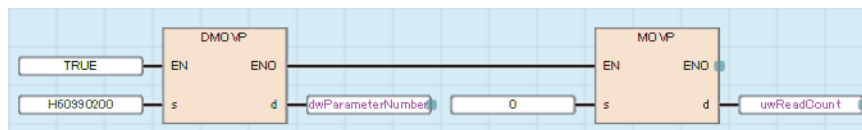
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### ■Labels used

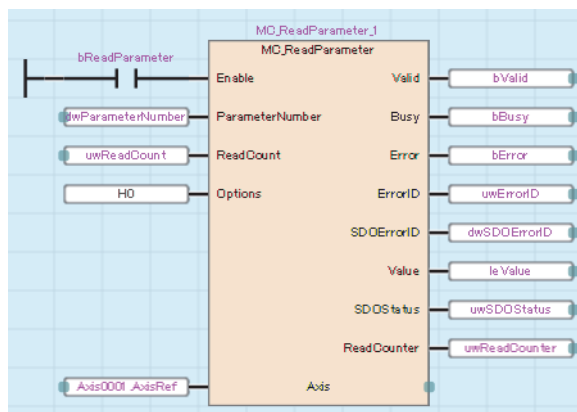
| Label name         | Data type                                                | Comment                 |
|--------------------|----------------------------------------------------------|-------------------------|
| MC_ReadParameter_1 | MC_ReadParameter                                         | Parameter Read FB       |
| bReadParameter     | Bit                                                      | Program read command    |
| dwParameterNumber  | Double word [unsigned]/bit string [32-bit] (hexadecimal) | Parameter No.           |
| uwReadCount        | Word [unsigned]/bit string [16-bit]                      | Number of reading times |
| bValid             | Bit                                                      | Output value valid      |
| bBusy              | Bit                                                      | Executing               |
| bError             | Bit                                                      | Error                   |
| uwErrorID          | Word [unsigned]/bit string [16-bit]                      | Error code              |
| dwSDOErrorID       | Double word [unsigned]/bit string [32-bit] (hexadecimal) | Transient error code    |
| leValue            | Double-precision real number                             | Read value              |
| uwSDOStatus        | Word [unsigned]/bit string [16-bit]                      | SDO transfer status     |
| uwReadCounter      | Word [unsigned]/bit string [16-bit]                      | Number of reading times |

### ■FBD/LD program

- Data setting for parameter read



- Parameter read





## ■ST program

//-----Data setting for parameter read-----

dwParameterNumber:= H60990200;

uwReadCount:= 0;

//-----Parameter read-----

MC\_ReadParameter\_1(

Axis:= Axis0001.AxisRef ,

Enable:= bReadParameter ,

ParameterNumber:= dwParameterNumber ,

ReadCount:= uwReadCount ,

Options:= H00000000 ,

Valid=> bValid ,

Busy=> bBusy ,

Error=> bError ,

ErrorID=> uwErrorID ,

SDOErrorID=> dwSDOErrorID ,

Value=> leValue ,

SDOStatus=> uwSDOStatus ,

ReadCounter=> uwReadCounter

);

# 45.8 Parameter Write

## MC\_WriteParameter

This FB writes objects of a device station.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                                                                                                                          |
|----------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_WriteParameter(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ParameterNumber:= ?DWORD? ,   Value:= ?LREAL? ,   ExecutionMode:= ?INT? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   SDOErrorID=&gt; ?DWORD? ,   SDOStatus=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Setting range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —             | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable  | Name              | Data type               | Input    | Setting range          | Default value | Description                                                                                                                                                                                                              |
|-----------------|-------------------|-------------------------|----------|------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute         | Execution command | BOOL                    | At start | TRUE, FALSE            | FALSE         | When this variable is set to TRUE, MC_WriteParameter (Parameter Write) is executed.                                                                                                                                      |
| ParameterNumber | Parameter No.     | DWORD(HEX)              | At start | 00010000H to FFFFFFFFH | 00000000H     | The object of a device station is set.<br>For details, refer to the following.<br>Page 1570 Parameter No. (ParameterNumber)                                                                                              |
| Value           | Setting value     | LREAL                   | At start | —                      | 0.0           | The setting value of the set parameter is set.                                                                                                                                                                           |
| ExecutionMode   | Execution mode    | INT (MC_EXECUTION_MODE) | At start | 0, 1                   | 0             | The writing method of the set parameter is set.<br>• 0: Execute immediately (mcImmediately)<br>• 1: Execute at completion (mcQueued)<br>For details, refer to the following.<br>Page 1571 Execution mode (ExecutionMode) |
| Options         | Options           | DWORD(HEX)              | At start | 00000000H to 00010000H | 00000000H     | The function options for MC_WriteParameter (Parameter Write) are set in the specified bit position.<br>For details, refer to the following.<br>Page 1571 Options (Options)                                               |

## Output variables

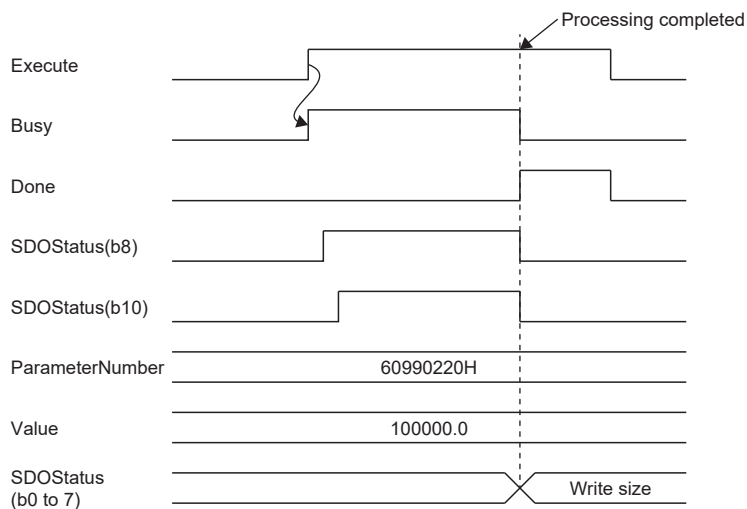
| Output variable | Name                 | Data type  | Default value | Description                                                                                                                                                                                                                                   |
|-----------------|----------------------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion | BOOL       | FALSE         | This variable becomes TRUE when the parameter writing is completed.                                                                                                                                                                           |
| Busy            | Executing            | BOOL       | FALSE         | This variable becomes TRUE when MC_WriteParameter (Parameter Write) is executed.                                                                                                                                                              |
| Error           | Error                | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                              |
| ErrorID         | Error code           | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |
| SDOErrorID      | Transient error code | DWORD(HEX) | 00000000H     | When an error occurs in SDO communication, this variable returns the response code (SDO Abort Code).                                                                                                                                          |
| SDOStatus       | SDO transfer status  | WORD(UINT) | 0             | This variable stores the processing status of the transient request.<br>For details, refer to the following.<br> Page 1571 SDO transfer status (SDOStatus)   |

## Processing details

- This FB writes object data by setting a value 00010000H or greater in Parameter No. (ParameterNumber). In this case, the object data is sent/received using the transient transmission function.
- When a transient request error (response code (SDO Abort Code)) is received from the device, Error (Error) becomes TRUE, SDO Communication Error (error code: 1A48H) is stored in Error code (ErrorID), and the response code (SDO Abort Code) from the device is stored in Transient error code (SDOErrorID).

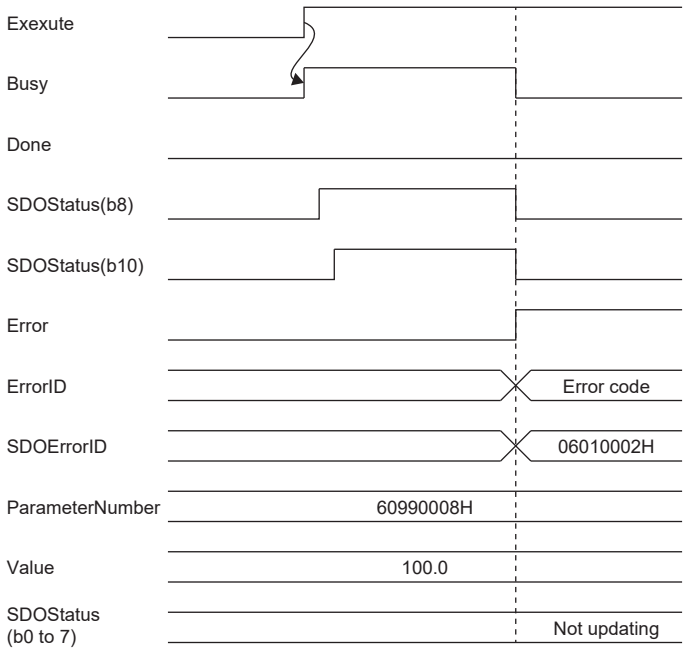
## Timing chart

- When the processing is completed successfully

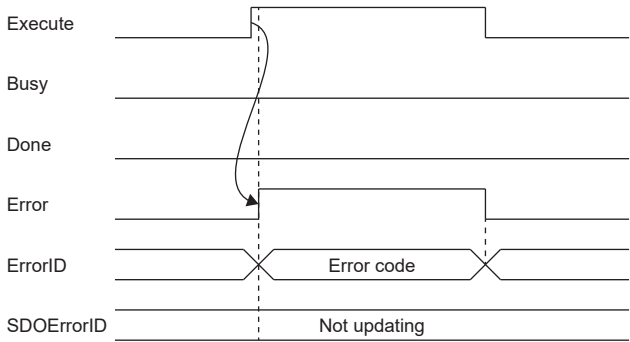


- When the processing is completed with an error

- SDO communication error



- I/O variable or input variable error

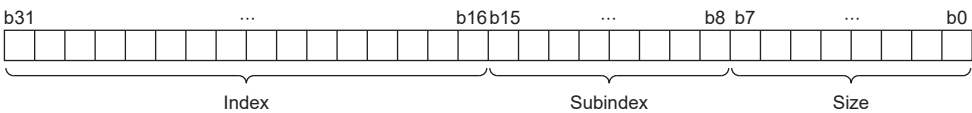


## Parameter No. (ParameterNumber)

- The classification of Parameter No. (ParameterNumber) set when writing parameters is shown below.

| Parameter No.          | Description                       |
|------------------------|-----------------------------------|
| 00010000H to FFFFFFFFH | The object of the device station. |

- The contents of Parameter No. (ParameterNumber) when setting the object of the device station are shown below.



- When setting the size of the objects of the device station, specify 1 byte (08H)/ 2 bytes (10H)/ 4 bytes (20H)/ 8 bytes (40H) in bits. If "00H" is specified, the parameter write is performed at 4 bytes. If a value other than the above setting values is specified, Out of Parameter No. Range (error code: 1BC2H) occurs.
- When the size specified with Parameter No. (ParameterNumber) differs from default size of the object data, the operations depend on the specifications of the drive unit.

### Ex.

When setting object index "6099H", UNSIGNED32 object of subindex "02H", and a size of "00H".  
Set "60990200H".

## ■Execution mode (ExecutionMode)

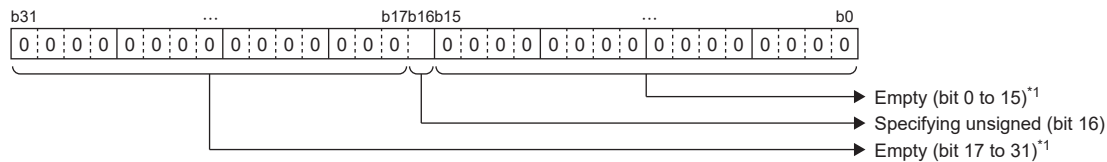
When executing a parameter write, set the timing of the write in Execution mode (ExecutionMode).

| Setting value                          | Description                                                                                                                                               |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Execute immediately (mcImmediately) | The write is executed immediately.<br>The axis operations might be affected because the reflection timing depends on each parameter.                      |
| 1: Execute at completion (mcQueued)    | The write is executed after the axis stops (Axis status ( <u>AxisName</u> .Md.AxisStatus) is "0: Axis disabled (Disabled)" or "4: Standby (Standstill)"). |

## ■Options (Options)

The function options for MC\_WriteParameter (Parameter Write) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.

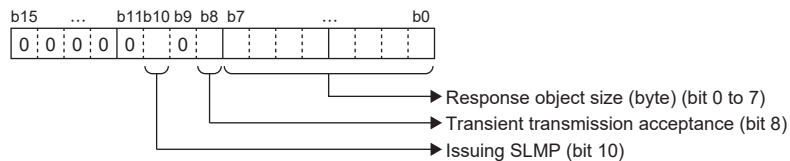


\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit | Name               | Description                                                                                                      |
|-----|--------------------|------------------------------------------------------------------------------------------------------------------|
| 16  | Specifies unsigned | Sets whether to store the read value of the integer data with or without a sign.<br>• 0: Signed<br>• 1: Unsigned |

## ■SDO transfer status (SDOStatus)

This variable stores the processing status of the transient request.



| Bit    | Name                                  | Description                                                                                                                  |
|--------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| 0 to 7 | Response object size (byte)           | Stores the object size sent by the device stations when the processing is completed.                                         |
| 8      | The transient transmission acceptance | Stores the transient transmission status.<br>• 0: Unexecuted transient transmission<br>• 1: Accepting transient transmission |
| 10     | Issuing SLMP                          | Stores the SLMP status.<br>• 0: Unexecuted SLMP<br>• 1: Issuing SLMP                                                         |

## Precautions

- Up to four transient transmissions can be executed toward the same axis. If MC\_WriteParameter (Parameter Write) is executed for object data towards an axis which is already executing four transient transmissions, Parameter Reading And Writing FB Execution Disabled Error (error code: 1BC1H) occurs and the next FB is not executed. (The FB being executed continues.)
- For the driver homing method, home position data of the drive unit is obtained using the transient transmission function. Therefore, if a parameter write for object data is executed when MC\_Home (OPR) is being executed, ABS Reference Point Read Error (error code: 1AF9H) may occur in MC\_Home (OPR).
- When writing the integer type/BOOL type parameters or object data, the setting value of MC\_WriteParameter (Parameter Write) is converted into an integer type or BOOL type and imported.

### Ex.

Writing parameters while specifying two bytes size in MC\_WriteParameter (Parameter Write).

| Setting value (Value)<br>(Data type: LREAL) | Write value (2 bytes data)                                    |                                                                 |
|---------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------|
|                                             | Specifies unsigned (Options (Options): Bit 16)<br>"0: Signed" | Specifies unsigned (Options (Options): Bit 16)<br>"1: Unsigned" |
| 10000.5                                     | 10000                                                         | 10000                                                           |
| -10000.4                                    | -10000                                                        | 55536                                                           |
| 65535.0                                     | -1                                                            | 65535                                                           |
| -65535.0                                    | 1                                                             | 1                                                               |
| 63356.0                                     | 0                                                             | 0                                                               |
| 131701.0                                    | -1                                                            | 65535                                                           |

- Values changed with MC\_WriteParameter (Parameter Write) are not saved. To use the changed values at the next power supply, save the parameters.  
For how to save parameters of objects of device stations, refer to the manual for the device stations.
- When devices in transient transmission are disconnected, all the transient requests for disconnected devices fail, and SDO Communication Error (error code: 1A48H) occurs.
- Before executing MC\_WriteParameter (Parameter Write), ensure that Driver status (AxisName.Md.Driver\_State) is not set to "-1: Axis variable not initialized/axis parameter error (Invalid)" or "0: Not Ready To Switch On (NotReadyToSwitchOn)". If executed in a status other than the above, Parameter Reading And Writing FB Execution Disabled Error (error code: 1BC1H) will occur.

## Program example

The following is a program example. The parameter write command (bWriteParameter) is set to TRUE, and "100.0" is written to the objects (index "6099H", subindex "02H", and size "00H") of Axis1 (Axis0001).

### Axis

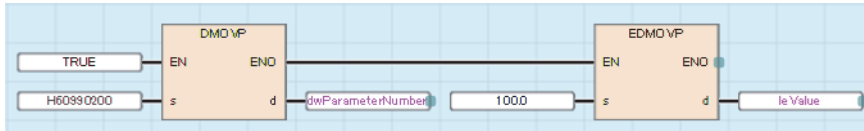
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### Labels used

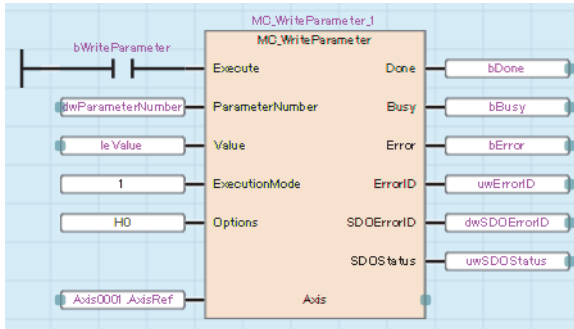
| Label name          | Data type                                                | Comment                 |
|---------------------|----------------------------------------------------------|-------------------------|
| MC_WriteParameter_1 | MC_WriteParameter                                        | Parameter Write FB      |
| bWriteParameter     | Bit                                                      | Parameter write command |
| dwParameterNumber   | Double word [unsigned]/bit string [32-bit] (hexadecimal) | Parameter No.           |
| leValue             | Double-precision real number                             | Setting value           |
| bDone               | Bit                                                      | Execution completion    |
| bBusy               | Bit                                                      | Executing               |
| bError              | Bit                                                      | Error                   |
| uwErrorID           | Word [unsigned]/bit string [16-bit]                      | Error code              |
| dwSDOErrorID        | Double word [unsigned]/bit string [32-bit] (hexadecimal) | Transient error code    |
| uwSDOStatus         | Word [unsigned]/bit string [16-bit]                      | SDO transfer status     |

## ■FBD/LD program

- Data setting for parameter write



- Parameter write



## ■ST program

//-----Data setting for parameter write-----

dwParameterNumber:= H60990200;

leValid:= 100.0;

//-----Parameter write-----

MC\_WriteParameter\_1(

Axis:= Axis0001.AxisRef ,

Execute:= bWriteParameter ,

ParameterNumber:= dwParameterNumber ,

Value:= leValue ,

ExecutionMode:= MC\_EXECUTION\_MODE\_\_mcQueued ,

Options:= H00000000 ,

Done=> bDone ,

Busy=> bBusy ,

Error=> bError ,

ErrorID=> uwErrorID ,

SDOErrorID=> dwSDOErrorID ,

SDOStatus=> uwSDOStatus

);

# 45.9 Axis Error Reset

## MC\_Reset

This FB resets errors and warnings of the axis.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                              |
|----------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_Reset(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

## Setting data

### I/O variables

| I/O variable | Name             | Data type | Input    | Setting range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —             | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

### Input variable

| Input variable | Name              | Data type  | Input    | Setting range | Default value | Description                                                                                                      |
|----------------|-------------------|------------|----------|---------------|---------------|------------------------------------------------------------------------------------------------------------------|
| Execute        | Execution command | BOOL       | At start | TRUE, FALSE   | FALSE         | When this variable is set to TRUE, MC_Reset (Axis Error Reset) is executed.                                      |
| Options        | Options           | DWORD(HEX) | At start | 0000000H      | 0000000H      | Set "00000000H".<br>* If a value other than "00000000H" is set, Out of Options Range (error code: 1BC3H) occurs. |

### Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                    |
|-----------------|-----------------------|------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when the error reset is completed.                                                                                                                  |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MC_Reset (Axis Error Reset) is executed.                                                                                                       |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when MC_Reset (Axis Error Reset) has been aborted because of timeout.<br>The variable becomes FALSE when Execution command (Execute) becomes FALSE. |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                               |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used                    |



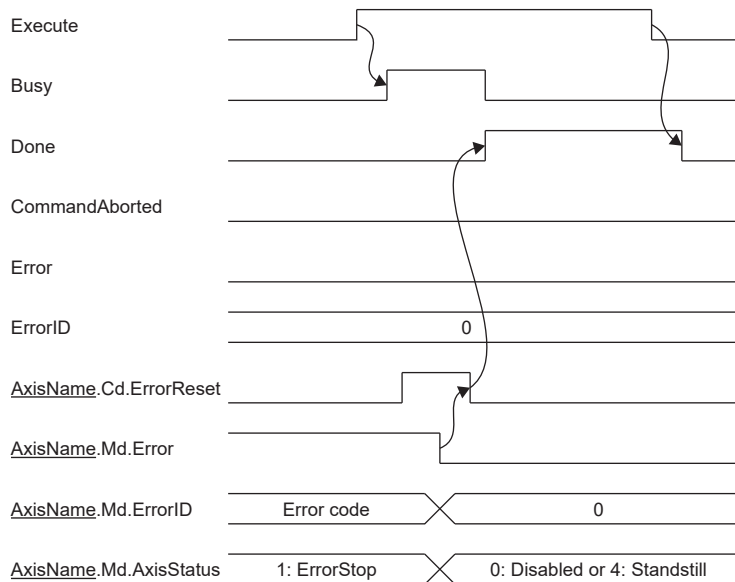
## Processing details

- This FB is executed when Execution command (Execute) is set to TRUE. When the processing starts, Executing (Busy) becomes TRUE and Axis error reset (AxisName.Cd.ErrorReset) of the target axis also becomes TRUE.
- Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE when clearing of the errors and warnings is completed.
- If executed when Axis status (AxisName.Md.AxisStatus) is other than "1: Stopping on error (ErrorStop)", Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE after the warnings are cleared.
- Errors and warnings are not cleared if Execution command (Execute) is set to TRUE while the error and warning causes still remain. If the error is not cleared within one second after the instruction is executed, Abortion of execution (CommandAborted) becomes TRUE. Turn Execution command (Execute) to FALSE temporarily and clear the error and warning causes, then set Execution command (Execute) to TRUE again.
- When an error occurs in MC\_Reset (Axis Error Reset), Error (Error) becomes TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

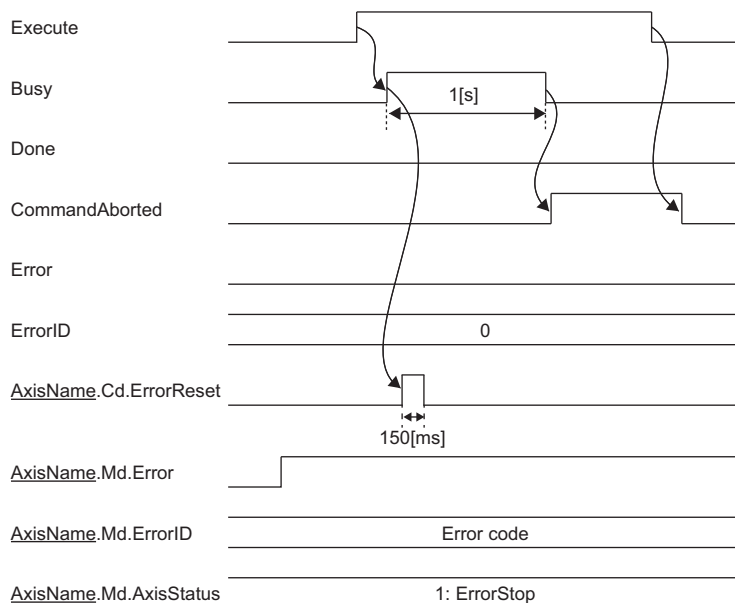
📖 User's manual for the controller used

### ■ Timing chart

- When the processing is completed successfully



- At timeout



## Precautions

Do not operate Axis error reset (AxisName.Cd.ErrorReset) directly while executing MC\_Reset (Axis Error Reset).

## Program example

The following is a program example. The error reset command (bErrorReset) is set to TRUE, and errors and warnings of Axis 1 (Axis0001) are reset.

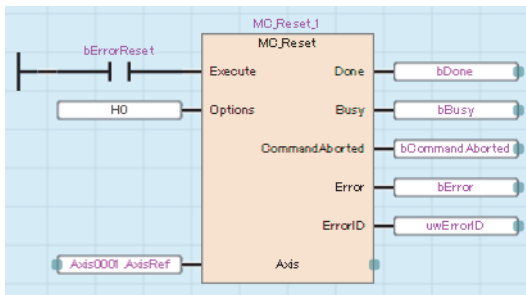
### ■Axis

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### ■Labels used

| Label name      | Data type                           | Comment               |
|-----------------|-------------------------------------|-----------------------|
| MC_Reset_1      | MC_Reset                            | Axis Error Reset FB   |
| bErrorReset     | Bit                                 | Error reset command   |
| bDone           | Bit                                 | Execution completion  |
| bBusy           | Bit                                 | Executing             |
| bCommandAborted | Bit                                 | Abortion of execution |
| bError          | Bit                                 | Error                 |
| uwErrorID       | Word [unsigned]/bit string [16-bit] | Error code            |

### ■FBD/LD program



### ■ST program

```
MC_Reset_1(  
  Axis:= Axis0001.AxisRef ,  
  Execute:= bErrorReset ,  
  Options:= H00000000 ,  
  Done=> bDone ,  
  Busy=> bBusy ,  
  CommandAborted=> bCommandAborted ,  
  Error=> bError ,  
  ErrorID=> uwErrorID  
);
```

# 45.10 Axes Group Error Reset

45

## MC\_GroupReset

This FB resets errors and warnings of the axes group and each axis in the axes group.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                              |
|----------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_GroupReset(   AxesGroup:= ?AXES_GROUP_REF? ,   Execute:= ?BOOL? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name                   | Data type      | Input    | Setting range | Default value         | Description                                                                                                                                                                                 |
|--------------|------------------------|----------------|----------|---------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxesGroup    | Axes group information | AXES_GROUP_REF | At start | —             | Omission not possible | An axes group is set.<br>For the variable ( <u>AxesGroupName</u> .AxesGroupRef.) used, refer to the following.<br>Page 1468 <u>AxesGroupName</u> .AxesGroupRef.<br>(Axes group information) |

#### Input variable

| Input variable | Name              | Data type  | Input    | Setting range | Default value | Description                                                                                                      |
|----------------|-------------------|------------|----------|---------------|---------------|------------------------------------------------------------------------------------------------------------------|
| Execute        | Execution command | BOOL       | At start | TRUE, FALSE   | FALSE         | When this variable is set to TRUE, MC_GroupReset (Axes Group Error Reset) is executed.                           |
| Options        | Options           | DWORD(HEX) | At start | 00000000H     | 00000000H     | Set "00000000H".<br>* If a value other than "00000000H" is set, Out of Options Range (error code: 1BC3H) occurs. |

#### Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                               |
|-----------------|-----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when the error reset of all axes in the axes group is completed.                                                                                               |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MC_GroupReset (Axes Group Error Reset) is executed.                                                                                                       |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when MC_GroupReset (Axes Group Error Reset) has been aborted because of timeout.<br>The variable becomes FALSE when Execution command (Execute) becomes FALSE. |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                          |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used                               |

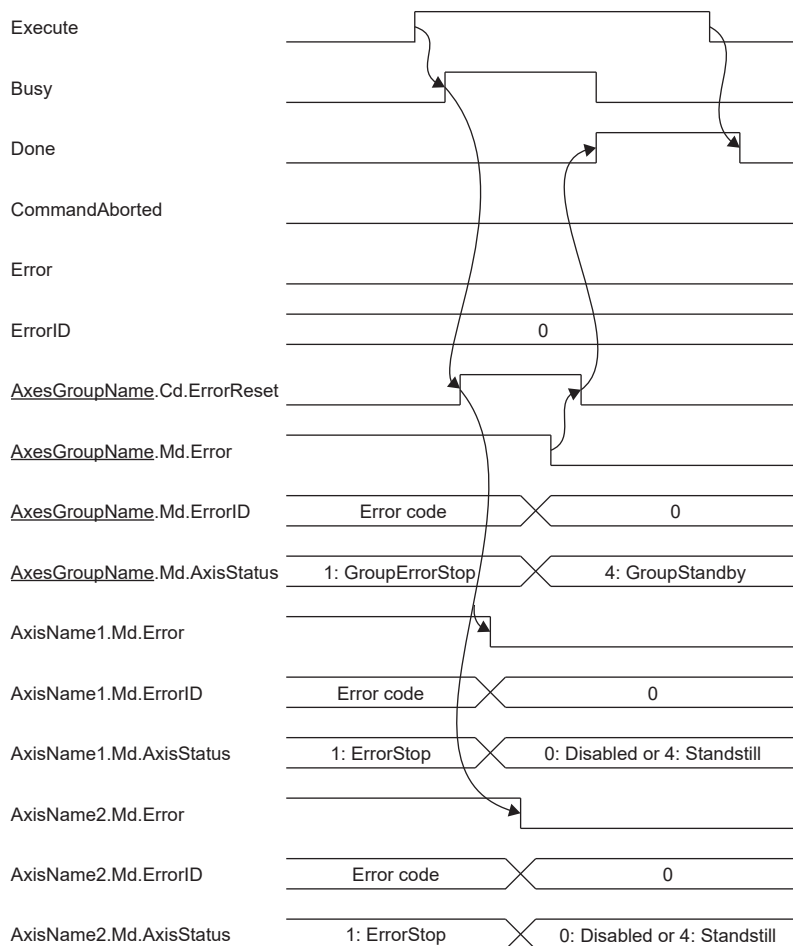
## Processing details

- This FB is executed at the rising edge of Execution command (Execute). When the processing starts, Executing (Busy) becomes TRUE and Axes group error reset (AxesGroupName.Cd.ErrorReset) of the target axes group also becomes TRUE.
- Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE when clearing of the errors and warnings is completed for the axes group or individual axis.
- If executed when Axes group status (AxesGroupName.Md.GroupStatus) is other than "1: Stopping on error (GroupErrorStop)", Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE after the warnings are cleared.
- Axis errors and warnings are not cleared if Execution command (Execute) is set to TRUE while the error and warning causes still remain. In this case, if the errors are not cleared within one second after the FB is executed, Abortion of execution (CommandAborted) becomes TRUE and Axes group error reset (AxesGroupName.Cd.ErrorReset) of the target axes group becomes FALSE. Set Execution command (Execute) to FALSE temporarily and clear the error and warning causes, then set Execution command (Execute) to TRUE again.
- When an error occurs in MC\_GroupReset (Axes Group Error Reset), Error (Error) becomes TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

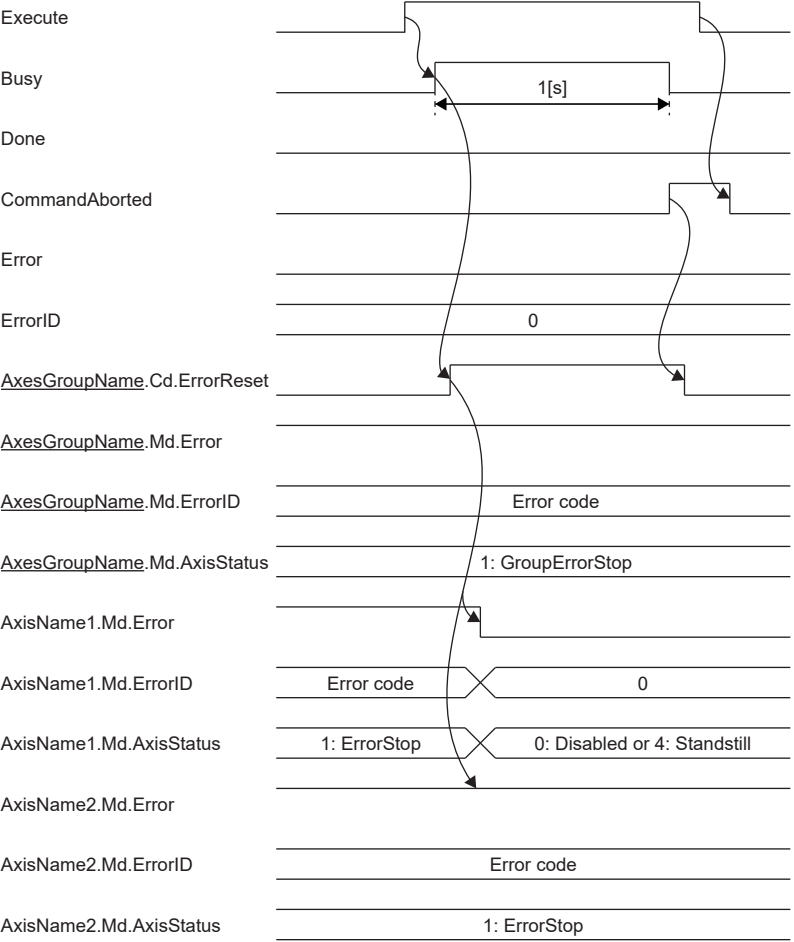
 User's manual for the controller used

### ■Timing chart

- When the processing is completed successfully



- At timeout



## Precautions

Do not operate Axes group error reset (AxesGroupName.Cd.ErrorReset) directly while executing MC\_GroupReset (Axes Group Error Reset).

## Program example

The following is a program example. The axes group error reset command (bGroupErrorReset) is set to TRUE, and errors and warnings of Axes group 1 (AxesGroup001) are reset.

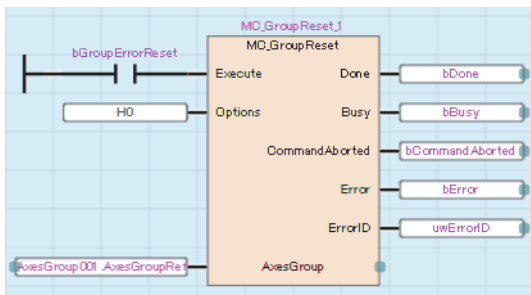
### ■Axes group

| Axes group No. | Label name   | Data type      | Comment      |
|----------------|--------------|----------------|--------------|
| 1              | AxesGroup001 | AXES_GROUP_REF | Axes group 1 |

### ■Labels used

| Label name       | Data type                           | Comment                        |
|------------------|-------------------------------------|--------------------------------|
| MC_GroupReset_1  | MC_GroupReset                       | Axes Group Error Reset FB      |
| bGroupErrorReset | Bit                                 | Axes group error reset command |
| bDone            | Bit                                 | Execution completion           |
| bBusy            | Bit                                 | Executing                      |
| bCommandAborted  | Bit                                 | Abortion of execution          |
| bError           | Bit                                 | Error                          |
| uwErrorID        | Word [unsigned]/bit string [16-bit] | Error code                     |

### ■FBD/LD program



### ■ST program

```

MC_GroupReset_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bGroupErrorReset ,
  Options:= H00000000 ,
  Done=> bDone ,
  Busy=> bBusy ,
  CommandAborted=> bCommandAborted ,
  Error=> bError ,
  ErrorID=> uwErrorID
);

```

# 45.11 Touch Probe Enabled

45

## MC\_TouchProbe

This FB records optional data when a trigger event occurs.

| Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | FBD/LD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The ladder diagram shows the following connections for MC_TouchProbe:</p> <ul style="list-style-type: none"> <li>DUT: Axis to Axis :DUT</li> <li>DUT: TriggerInput to TriggerInput :DUT</li> <li>B: Execute to Done :B</li> <li>B: ContinuousUpdate to Busy :B</li> <li>B: WindowOnly to CommandAborted :B</li> <li>L: FirstPosition to Error :B</li> <li>L: LastPosition to ErrorID :UW</li> <li>DUT: ProbeData to PositionData :L</li> <li>L: CompensationTime to RecordedPosition :L</li> <li>ENUM: RecordMode to RecordedCounter :UW</li> <li>UW: RecordCount to TouchProbeID :UW</li> <li>DUT: OutputBuffer to OutputBuffer</li> </ul> | <p>The FBD/LD diagram shows the following connections for MC_TouchProbe:</p> <ul style="list-style-type: none"> <li>Execute to Done</li> <li>ContinuousUpdate to Busy</li> <li>WindowOnly to CommandAborted</li> <li>FirstPosition to Error</li> <li>LastPosition to ErrorID</li> <li>ProbeData to PositionData</li> <li>CompensationTime to RecordedPosition</li> <li>RecordMode to RecordedCounter</li> <li>RecordCount to TouchProbeID</li> <li>OutputBuffer to OutputBuffer</li> <li>Axis to Axis</li> <li>TriggerInput to TriggerInput</li> </ul> | <pre> MC_TouchProbe(   Axis:= ?AXIS_REF? ,   TriggerInput:= ?MC_TRIGGER_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   WindowOnly:= ?BOOL? ,   FirstPosition:= ?LREAL? ,   LastPosition:= ?LREAL? ,   ProbeData:= ?TARGET_REF? ,   CompensationTime:= ?LREAL? ,   RecordMode:= ?INT? ,   RecordCount:= ?WORD? ,   OutputBuffer:= ?TARGET_REF? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   PositionData=&gt; ?LREAL? ,   RecordedPosition=&gt; ?LREAL? ,   RecordedCounter=&gt; ?WORD? ,   TouchProbeID=&gt; ?WORD? ); </pre> |

## Setting data

### I/O variables

| I/O variable | Name                 | Data type          | Input    | Setting range | Default value         | Description                                                                                                                                                    |
|--------------|----------------------|--------------------|----------|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information     | AXIS_REF           | At start | —             | Omission possible     | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |
| TriggerInput | Trigger input signal | MC_TRIGGE<br>R_REF | At start | —             | Omission not possible | The trigger input signal is set.<br>For details, refer to the following.<br>Page 1586 Trigger input signal (TriggerInput)                                      |

### Input variables

| Input variable   | Name              | Data type | Input                                                          | Setting range  | Default value | Description                                                                                                                                                                                                                                                                                                                                                           |
|------------------|-------------------|-----------|----------------------------------------------------------------|----------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute          | Execution command | BOOL      | At start                                                       | TRUE,<br>FALSE | FALSE         | When this variable is set to TRUE, MC_TouchProbe (Touch Probe Enabled) is executed.                                                                                                                                                                                                                                                                                   |
| ContinuousUpdate | Continuous update | BOOL      | At start                                                       | TRUE,<br>FALSE | FALSE         | Whether to enable or disable continuous change of Enabled window (WindowOnly), Lower limit position (FirstPosition), and Upper limit position (LastPosition) is set.<br>• FALSE: Disabled<br>• TRUE: Enabled                                                                                                                                                          |
| WindowOnly       | Enabled window    | BOOL      | At start/<br>Retrigger possible/<br>Continuous update possible | TRUE,<br>FALSE | FALSE         | Whether to detect trigger events only in the area defined by the lower limit position and the upper limit position or not is set.<br>• FALSE: Detected in entire area<br>• TRUE: Detected in set area only<br>For details, refer to the following.<br>Page 1587 Enabled window (WindowOnly)/ Lower limit position (FirstPosition)/Upper limit position (LastPosition) |

| Input variable   | Name                           | Data type            | Input                                                          | Setting range   | Default value | Description                                                                                                                                                                                                                                                                                                                                                                   |
|------------------|--------------------------------|----------------------|----------------------------------------------------------------|-----------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FirstPosition    | Lower limit position           | LREAL                | At start/<br>Retrigger possible/<br>Continuous update possible | —               | 0.0           | The lower limit position of the trigger event valid area is set.<br>The set value is included in the valid area.<br>For details, refer to the following.<br> Page 1587 Enabled window (WindowOnly)/<br>Lower limit position (FirstPosition)/Upper limit position (LastPosition)              |
| LastPosition     | Upper limit position           | LREAL                | At start/<br>Retrigger possible/<br>Continuous update possible | —               | 0.0           | The upper limit position of the trigger event valid area is set.<br>The set value is included in the valid area.<br>For details, refer to the following.<br> Page 1587 Enabled window (WindowOnly)/<br>Lower limit position (FirstPosition)/Upper limit position (LastPosition)              |
| ProbeData        | Probe data                     | TARGET_REF           | At start                                                       | —               | —             | The probe data is set.<br>For details, refer to the following.<br> Page 1588 Probe data (ProbeData)                                                                                                                                                                                          |
| CompensationTime | Compensation time              | LREAL                | At start                                                       | -5.0 to 5.0 [s] | 0.0           | The value to compensate for a delay of the touch probe processing is set.<br>Set a positive value to compensate for a delay.<br>For details, refer to the following.<br> Page 1589 Compensation time (CompensationTime)                                                                      |
| RecordMode       | Latch mode                     | INT (MC_RECORD_MODE) | At start                                                       | 0 to 2          | 0             | The data latch method is set.<br><ul style="list-style-type: none"> <li>• 0: One shot mode (OneShot)</li> <li>• 1: Frequency specified mode (RecordCount)</li> <li>• 2: Ring buffer mode (RingBuffer)</li> </ul> For details, refer to the following.<br> Page 1590 Latch mode (RecordMode) |
| RecordCount      | Number of latch times          | WORD(UINT)           | At start                                                       | 1 to 65535      | 1             | The number of latch times is set.<br>For details, refer to the following.<br> Page 1590 Number of latch times (RecordCount)                                                                                                                                                                |
| OutputBuffer     | Storage location of latch data | TARGET_REF           | At start                                                       | —               | —             | The storage location of the latch data is set.<br>When omitted, latch data is output only to Latch position (RecordedPosition).<br>For details, refer to the following.<br> Page 1591 Storage location of latch data (OutputBuffer)                                                        |

## ■ Output variables

| Output variable  | Name                       | Data type  | Default value | Description                                                                                                                                                                                                                                     |
|------------------|----------------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done             | Completion                 | BOOL       | FALSE         | This variable becomes TRUE when the control is completed.                                                                                                                                                                                       |
| Busy             | Executing                  | BOOL       | FALSE         | This variable becomes TRUE when MC_TouchProbe (Touch Probe Enabled) is executed.                                                                                                                                                                |
| CommandAborted   | Abortion of execution      | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_TouchProbe (Touch Probe Enabled) is aborted because of an error or multiple start.                                                                                                              |
| Error            | Error                      | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                |
| ErrorID          | Error code                 | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |
| PositionData     | Current value monitor data | LREAL      | 0.0           | The current value of the latch target data is stored.                                                                                                                                                                                           |
| RecordedPosition | Latch position             | LREAL      | 0.0           | The current value when a trigger event occurred is set.<br>When latch is executed multiple times, the data is overwritten by the latest data.                                                                                                   |
| RecordedCounter  | Number of latch times      | WORD(UINT) | 0             | The number of latch times is stored.                                                                                                                                                                                                            |
| TouchProbeID     | Probe ID                   | WORD(UINT) | 0             | An ID unique to MC_TouchProbe (Touch Probe Enabled) is stored.                                                                                                                                                                                  |



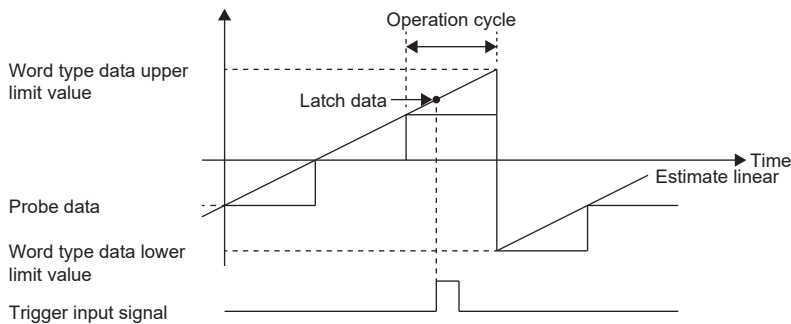
## Processing details

- This FB estimates and calculates the latch data on the rising edge/falling edge/both directions of the signal specified in Trigger input signal (TriggerInput).
- When Enabled window (WindowOnly) is TRUE, checks whether the latch data at trigger event occurrence is within the range of Lower limit position (FirstPosition) and Upper limit position (LastPosition) or not. Data outside the range are not latched.
- The latch data is stored to the storage location set in Latch position (RecordedPosition) or Storage location of latch data (OutputBuffer) according to Latch mode (RecordMode), and Number of latch times (RecordedCounter) is updated.
- The probe data during operation cycle interval is calculated by estimation. The value calculated by estimation when Trigger input signal (TriggerInput) is input is the latch data. The value is calculated as shown in the figure below.

■ When the probe data is WORD type

- When using an external signal high-accuracy input

The trigger input timing is the time when the device station detects the signal.



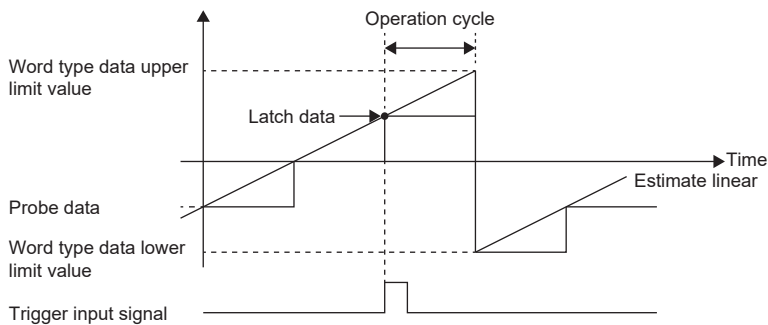
- \* For setting method of high-accuracy input of the external signal selection, refer to the following.

📖 User's manual for the controller used

- \* For the accuracy of signal detection time, refer to the manuals for the device used.

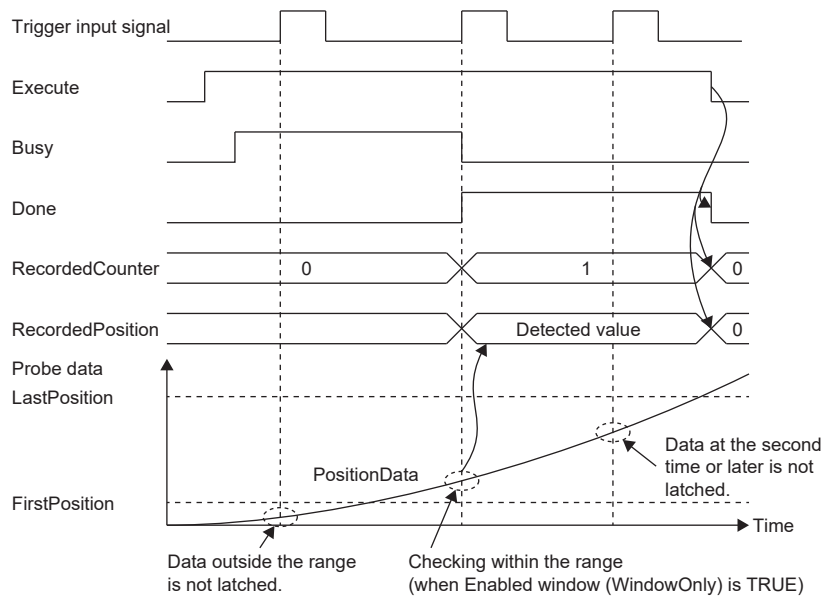
- When not using an external signal high-accuracy input

The trigger input timing is the operation cycle.

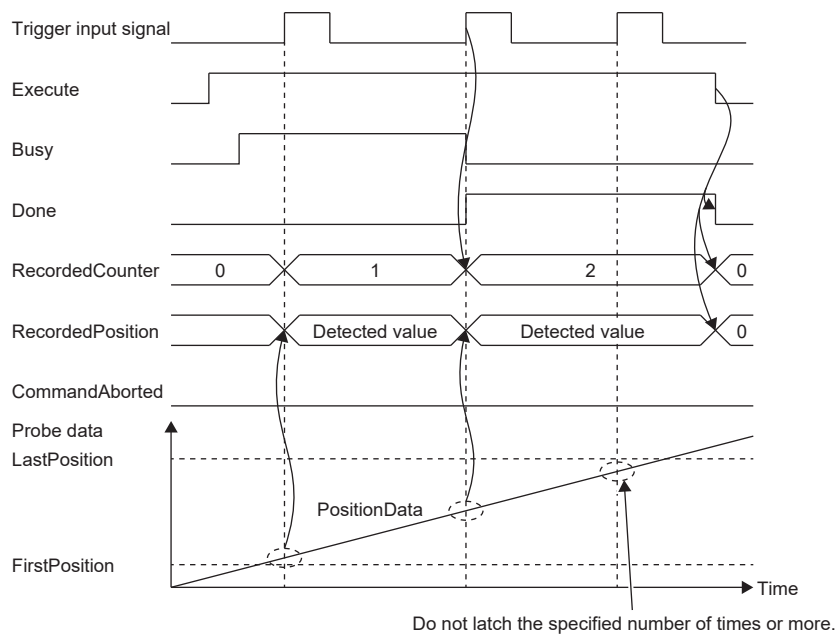


## ■Timing chart

- When the processing is completed successfully
- When Latch mode (RecordMode) is "0: One shot mode (OneShot)"

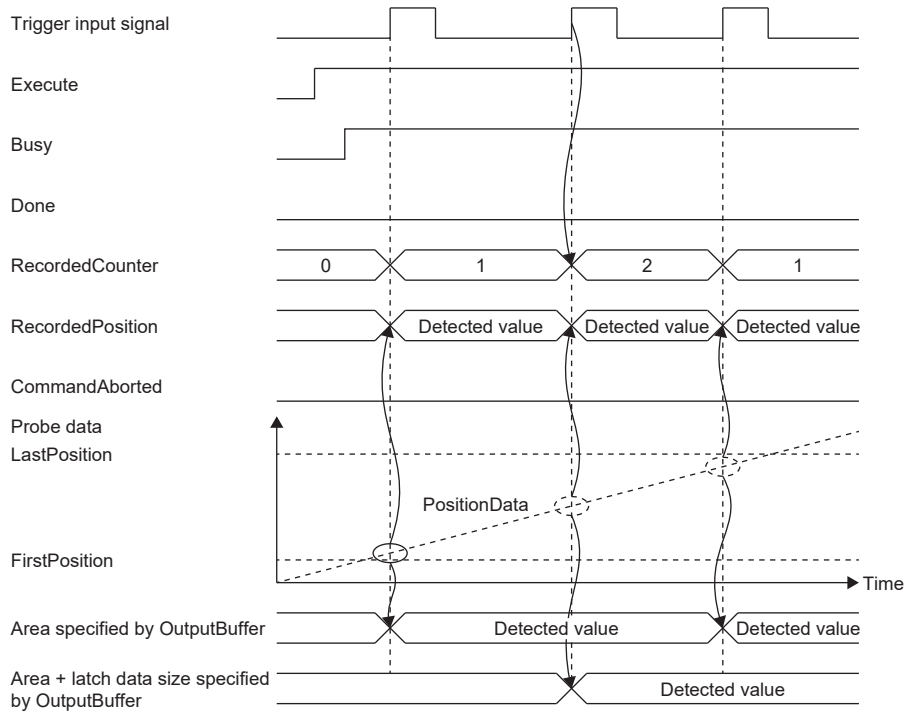


- When Latch mode (RecordMode) is "1: Frequency specified mode (RecordCount)"
- When Number of latch times (RecordCount) is two



- When Latch mode (RecordMode) is "2: Ring buffer mode (RingBuffer)"

When Number of latch times (RecordCount) is two



- When the processing is completed with an error

For the timing chart, refer to the following.

 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■Trigger input signal (TriggerInput)

Trigger input signal is set in the MC\_TRIGGER\_REF structure. For the MC\_TRIGGER\_REF structure, refer to the following.

📖 Page 1487 MC\_TRIGGER\_REF

The setting range for Trigger input signal (Signal) of the MC\_TRIGGER\_REF structure set in Trigger input signal (TriggerInput) is shown below.

The type for Trigger signal (Signal) is SIGNAL\_SELECT structure. For the SIGNAL\_SELECT structure, refer to the following.

📖 Page 1492 SIGNAL\_SELECT (Signal select)

| Structures                    | Variable name                        | Type                                                       | Setting range                                                                                                                                                                                                                                    |
|-------------------------------|--------------------------------------|------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SIGNAL_SELECT (Signal select) | Source (Signal)                      | TARGET_REF<br>📖 Page 1489<br>TARGET_REF (Input signal)     | <b>■Type</b> <ul style="list-style-type: none"> <li>• BOOL</li> </ul> <b>■Data category</b> <ul style="list-style-type: none"> <li>• [OBJ]<sup>*1,2</sup></li> <li>• [LINK]</li> <li>• [VAR]</li> <li>• [DEV]</li> <li>• [CONST]</li> </ul>      |
|                               | Detection (Signal detection method)  | INT<br>(MC_SIGNAL_LOGIC)<br>📖 Page 1524<br>MC_SIGNAL_LOGIC | <ul style="list-style-type: none"> <li>• 2: Detection at FALSE → TRUE (rising edge) (RisingEdge)</li> <li>• 3: Detection at TRUE → FALSE (falling edge) (FallingEdge)</li> <li>• 4: Detection at rising edge/falling edge (BothEdges)</li> </ul> |
|                               | CompensationTime (Compensation time) | LREAL                                                      | -5.0 to 5.0 [s]                                                                                                                                                                                                                                  |
|                               | FilterTime (Filter time)             | LREAL                                                      | 0.0 to 5.0 [s]                                                                                                                                                                                                                                   |

\*1 When the target modification is omitted, the object of Axis Information (Axis) axis is referred to. However, if the Axis Information (Axis) axis does not have a station address, or if a station address has not been set, External signal selection incorrect (error code: 1B31H, 1B32H, 1BD6H, or 1BD7H) occurs. When the station address for the target modification has been specified, the Axis Information (Axis) is ignored.

When the referred station has the Axis Emulate function enabled and also has a set station address, the emulating object will be referred to.

To use external signal high-accuracy input, set Detection (Signal detection method) to 4: Detection at rising edge/falling edge (BothEdges).

\*2 External signal high-accuracy input can be used. For details, refer to the following.

📖 User's manual for the controller used

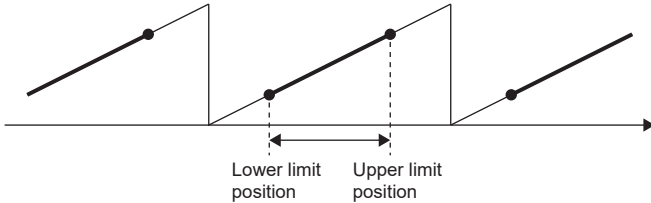
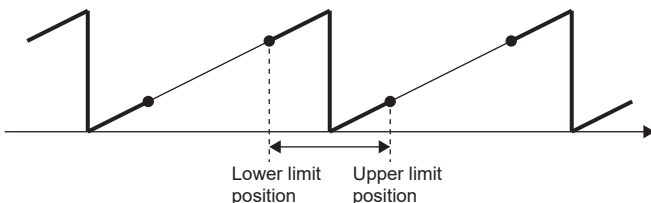
When a signal that cannot be used for Signal name (TriggerInput.Signal.Source.Target) is used, one of the following errors will be output: External signal selection string incorrect (error code: 1B05H), External signal selection incorrect (error code: 1B31H, 1B32H, 1BD6H, or 1BD7H), or Add-on Signal IO internal error (error code: 1B33H or 1BD8H).

### Point

When using an external signal high-accuracy input, set the Filter time (TriggerInput.Signal.FilterTime) to "0". If set to a value other than "0", the signal detection time will not be correctly obtained. If the device station has an input filter, use this device station filter. If the device station does not have an input filter, use the Window enabled (WindowOnly), Lower limit position (FirstPosition), and Upper limit position (LastPosition) of Touch Probe Enabled (MC\_TouchProbe) together to prevent a false detection of the trigger signal due to noise.

■ **Enabled window (WindowOnly)/Lower limit position (FirstPosition)/Upper limit position (LastPosition)**

When Enabled window (WindowOnly) is valid (TRUE), triggers are detected only within the range between Lower limit position (FirstPosition) and Upper limit position (LastPosition) of the probe data. When it is invalid (FALSE), the touch probe processing is executed for the entire range.

| Lower limit position (FirstPosition)/Upper limit position (LastPosition) relation | Touch probe processing                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lower limit position (FirstPosition) ≤ Upper limit position (LastPosition)        | <p>The touch probe processing is executed when the probe data is more than Lower limit position (FirstPosition) and less than Upper limit position (LastPosition).</p>  |
| Lower limit position (FirstPosition) > Upper limit position (LastPosition)        | <p>The touch probe processing is executed when the probe data is less than Upper limit position (LastPosition) or more than Lower limit position (FirstPosition).</p>   |

## ■Probe data (ProbeData)

Set the data to latch in the TARGET\_REF structure. For the TARGET\_REF structure, refer to the following.

📖 Page 1489 TARGET\_REF (Input signal)

The settable data categories are shown below.

| Data classification                             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [AXIS]                                          | The axis data of Axis Information (Axis) is referred to.<br>The target modification (such as @Position) needs to be set.                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| [VAR]                                           | Axis information (Axis) is ignored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| [DEV]                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| [OBJ]<br>(which has been mapped to cyclic data) | <ul style="list-style-type: none"> <li>When the station address for the target modification has been specified, the Axis Information (Axis) is ignored.</li> <li>When the target modification is omitted, the object of Axis Information (Axis) axis is referred to. However, if the Axis Information (Axis) axis does not have a station address, or if a station address has not been set, an error will occur.</li> <li>When the referred station has the Axis Emulate function enabled and also has a set station address, the emulating object will be referred to.</li> </ul> |

When a signal that cannot be used for Signal name (TARGET\_REF.Target) is used, one of the following errors will be output: External signal selection string incorrect (error code: 1B05H), External signal selection incorrect (error code: 1B31H, 1B32H, 1BD6H, or 1BD7H), or Add-on Signal IO internal error (error code: 1B33H or 1BD8H).

- The data is updated as the ring counter. The upper limit value and lower limit value of the ring counter differ depending on the data classification and data type of Probe data (ProbeData).

| Data classification | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [AXIS]              | <ul style="list-style-type: none"> <li>■When the target modification is set to "@Position" <ul style="list-style-type: none"> <li>The ring counter upper limit value and ring counter lower limit value of the axis are used.</li> </ul> </li> <li>■When the target modification is set to "@CumulativePos" <ul style="list-style-type: none"> <li>The positioning range upper limit value and positioning range lower limit value of the axis are used.</li> </ul> </li> </ul> |
| [VAR]               | The maximum value and minimum value of the data type are used.                                                                                                                                                                                                                                                                                                                                                                                                                  |
| [DEV]               | <Example>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| [OBJ]               | When [VAR] is set to a Word type label. <ul style="list-style-type: none"> <li>Ring counter upper limit value: 65535</li> <li>Ring counter lower limit value: 0</li> </ul>                                                                                                                                                                                                                                                                                                      |

### Restriction

Ensure that the change amount per operation cycle satisfies the following formula. Failing to do so may cause the actual change amount of the probe data and the latched change amount to not match.

$$\text{Variation amount of one operation cycle} < \frac{|\text{(ring counter maximum value)} - \text{(ring counter minimum value)}| + 1}{2}$$

## ■ Compensation time (CompensationTime)

Compensates for the delay time of the touch probe processing. Set this variable to compensate for delays specific to the touch probe processing separately from the compensation time of the trigger input signal. To compensate for delays, set a positive number. To compensate for the progression, set a negative number.

The total compensation time = Compensation time (CompensationTime) - Compensation time (TriggerInput.Signal.CompensationTime)

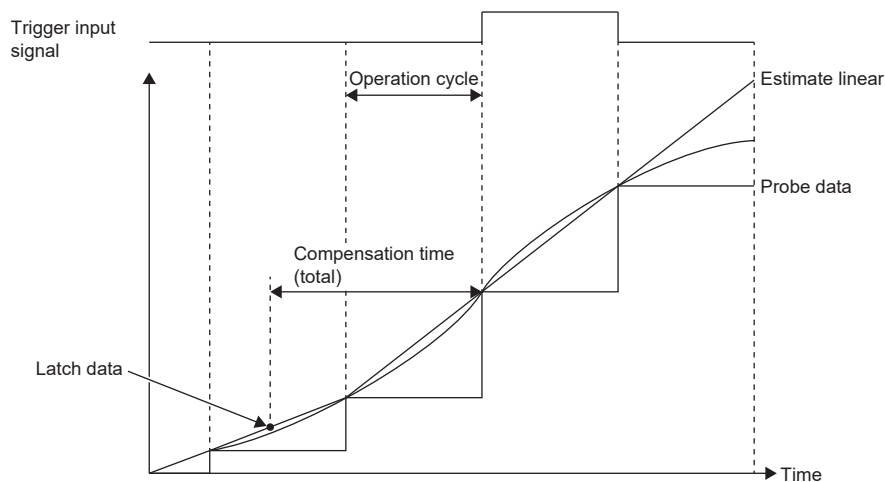
### Point

When compensating for the delay time, the past value is used for latch data estimate calculation. As such, the maximum accuracy is reached when the compensation time is passed after Executing (Busy) becomes TRUE. In addition, memory is consumed as shown below depending on the compensation time and the operation cycle.

- Memory consumption = 24 bytes × (total compensation time ÷ operation cycle)

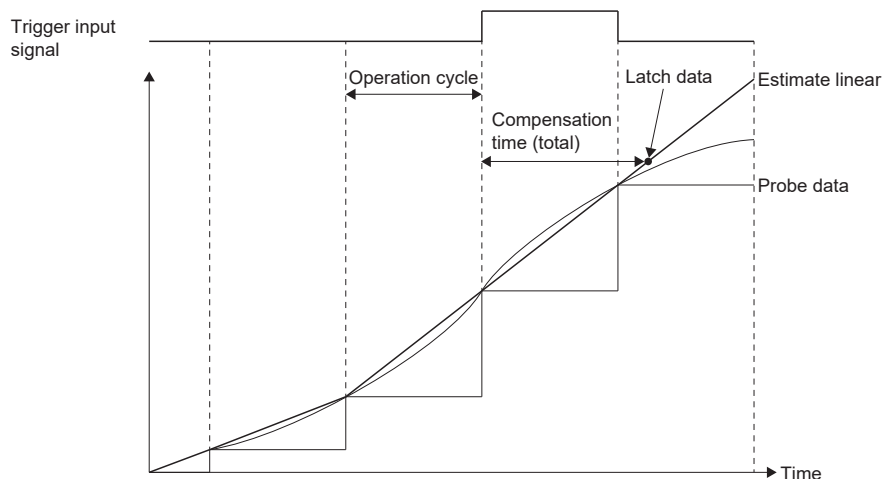
- When compensating for delays (when the total compensation time is a positive number)

The estimate is calculated based on the operation cycle data after latching and before the compensation time is passed.



- When compensating for the progression (when the total compensation time is a negative number)

The estimate is calculated based on the operation cycle data at latching.



## ■Latch mode (RecordMode)

Sets the latch method for the data. The latch methods are shown below.

| Setting value                             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: One shot mode (OneShot)                | Stores latch data one time only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 1: Frequency specified mode (RecordCount) | <ul style="list-style-type: none"><li>• Stores latch data a number of times equal to the setting value of Number of latch times (RecordCount).</li><li>• Starting from the storage location specified in Storage location of latch data (OutputBuffer), stores latch data in an area shifted for the latch data size each latch.</li><li>• To stop the touch probe function before latching completes for the number of times set in Number of latch times (RecordCount), execute MC_AbortTrigger (Touch Probe Disabled).</li></ul>                                                                                                               |
| 2: Ring buffer mode (RingBuffer)          | <ul style="list-style-type: none"><li>• Stores latch data to the ring buffer a number of times equal to the setting value of Number of latch times (RecordCount). The latch operation is always performed.</li><li>• Starting from the storage location specified in Storage location of latch data (OutputBuffer), shifts for the latch data size each latch and stores latch data to the ring buffer of Number of latch times (RecordCount).</li><li>• To stop the touch probe function before latching completes for the number of times set in Number of latch times (RecordCount), execute MC_AbortTrigger (Touch Probe Disabled).</li></ul> |

- Based on the setting of Latch mode (RecordMode), the following values are stored in Number of latch times (RecordedCounter) or Latch position (RecordedPosition).

| Latch mode (RecordMode)                   | Number of latch times (RecordedCounter)                                                                                 | Latch position (RecordedPosition)                     |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| 0: One shot mode (OneShot)                | Becomes "1" at latch operation.                                                                                         | Stores latch data one time only.                      |
| 1: Frequency specified mode (RecordCount) | Adds "+1" at each latch operation.                                                                                      | Stores the latest latch data at each latch operation. |
| 2: Ring buffer mode (RingBuffer)          | Adds "+1" at each latch operation.<br>Returns to "0" when the value of Number of latch times (RecordCount) is exceeded. | Stores the latest latch data at each latch operation. |

## ■Number of latch times (RecordCount)

Based on the setting of Latch mode (RecordMode), the following values are stored in Number of latch times (RecordCount).

| Latch mode (RecordMode)                   | Number of latch times (RecordCount)                                                                                               |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| 0: One shot mode (OneShot)                | Ignored.                                                                                                                          |
| 1: Frequency specified mode (RecordCount) | The number of latch times is set. When the setting is out of range, Latch Count Incorrect (error code: 1B8AH) occurs.             |
| 2: Ring buffer mode (RingBuffer)          | Sets the number of times for the ring buffer. When the setting is out of range, Latch Count Incorrect (error code: 1B8AH) occurs. |



## ■Storage location of latch data (OutputBuffer)

Set the storage location of the latched data in the TARGET\_REF structure. For the TARGET\_REF structure, refer to the following.

📖 Page 1489 TARGET\_REF (Input signal)

- The usable data classifications are [VAR] and [DEV].
- As latched data will be stored as LREAL type, when setting non-LREAL type data in Target (Target) of the TARGET\_REF structure, set "(LREAL)" explicitly to the data type.
- The storage location of the latched data is shown below.

| Latch mode (RecordMode)                   | Storage location                                                                                                                              |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 0: One shot mode (OneShot)                | The area specified in Storage location of latch data (OutputBuffer).                                                                          |
| 1: Frequency specified mode (RecordCount) | Following area<br>Area specified in Storage location of latch data (OutputBuffer) + Number of latch times (RecordedCounter) × latch data size |
| 2: Ring buffer mode (RingBuffer)          |                                                                                                                                               |

- Storage location of latch data (OutputBuffer) can be omitted. When omitted, the latch data is only stored in Latch position (RecordedPosition).
- A setting example in which Storage location of latch data (OutputBuffer) is set in Target (Target) of the TARGET\_REF structure is shown below.

**Ex.**

When the following settings are used

| Example | Description                                                                                                                                                                                                                                                                                     | Setting                                                                                                                                       |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <ul style="list-style-type: none"> <li>• When Latch mode (RecordMode) is "0: One shot mode (OneShot)"</li> <li>• When Number of latch times (RecordCount) is "1" while Latch mode (RecordMode) is "1: Frequency specified mode (RecordCount)" or "2: Ring buffer mode (RingBuffer)".</li> </ul> | <ul style="list-style-type: none"> <li>• [VAR]OutputBufferData1<sup>*1</sup></li> </ul>                                                       |
| 2       | <ul style="list-style-type: none"> <li>• When Number of latch times (RecordCount) is "100" while Latch mode (RecordMode) is "1: Frequency specified mode (RecordCount)" or "2: Ring buffer mode (RingBuffer)".</li> </ul>                                                                       | <ul style="list-style-type: none"> <li>• [VAR]OutputBufferData2<sup>*2</sup></li> <li>• [VAR](LREAL)OutputBufferData3<sup>*3</sup></li> </ul> |

\*1 "OutputBufferData1" is an LREAL type instance

\*2 "OutputBufferData2" is an LREAL[0..99] type instance

\*3 "OutputBufferData3" is a WORD[0..399] type instance

- When the number of elements set in Storage location of latch data (OutputBuffer) is less than the value of Number of latch times (RecordCount), Latch Data Storage Shortage (error code: 1BBFH) occurs. Latch Data Storage Shortage (error code: 1BBFH) also occurs when access outside the device or label range is made during latch operation.
- The relation between the setting value and operation of each item is shown below.

| Latch mode (RecordMode)                   | Number of latch times (RecordCount)                    | Storage location of latch data (OutputBuffer) | Detection operation | Data storage location                    |
|-------------------------------------------|--------------------------------------------------------|-----------------------------------------------|---------------------|------------------------------------------|
| 0: One shot mode (OneShot)                | Within the setting range/<br>outside the setting range | Omit                                          | One time            | Latch position (RecordedPosition)        |
|                                           |                                                        | Set                                           |                     | Latch position (RecordedPosition)/buffer |
| 1: Frequency specified mode (RecordCount) | Outside the setting range                              | Omit/Set                                      | Error               | —                                        |
|                                           |                                                        |                                               |                     |                                          |
|                                           | Within the setting range                               | Omit                                          | Setting number      | Latch position (RecordedPosition)        |
|                                           |                                                        | Set                                           |                     | Latch position (RecordedPosition)/buffer |
| 2: Ring buffer mode (RingBuffer)          | Outside the setting range                              | Omit/Set                                      | Error               | —                                        |
|                                           |                                                        |                                               |                     |                                          |
|                                           | Within the setting range                               | Omit                                          | Always              | Latch position (RecordedPosition)        |
|                                           |                                                        | Set                                           |                     | Latch position (RecordedPosition)/buffer |

## Precautions

- The touch probe is controlled (detection and latch of trigger input signals) in the following operation cycles, regardless of the FB call task (scan/fixed cycle/event). The detection cycle of trigger input signals differs depending on the data category set in TriggerInput.

| Category                             | Period                                    |
|--------------------------------------|-------------------------------------------|
| [VAR]                                | First operation cycle                     |
| [DEV]                                |                                           |
| [CONST]                              |                                           |
| [OBJ]                                | Communication cycle of the target station |
| [LINK]                               |                                           |
| [VAR] With a network label specified |                                           |

The data set in the probe data (ProbeData) is latched at the following cycles.

| Category                             | Period                                     |
|--------------------------------------|--------------------------------------------|
| [VAR]                                | First operation cycle                      |
| [DEV]                                |                                            |
| [OBJ]                                |                                            |
| [LINK]                               | Communication cycle of the target station  |
| [VAR] With a network label specified |                                            |
| [AXIS]                               |                                            |
| [AXIS]                               | Control operation cycle of the target axis |

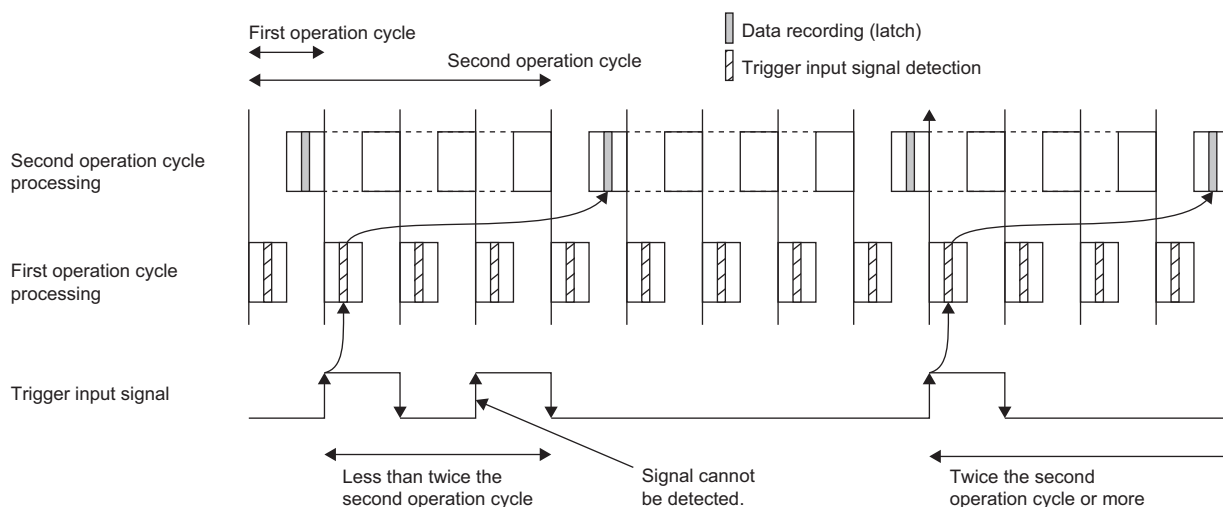
- MC\_TouchProbe (Touch Probe Enabled) is executed even if the target axis is unconnected or an error occurs.
- The time for each TRUE and FALSE of the trigger input signal must be longer than the following. If the time is short, the signal cannot be detected correctly.

| External signal high-accuracy input | The time for each TRUE and FALSE of the trigger input signal                                                                                         |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use                                 | <ul style="list-style-type: none"> <li>Device station: Device station filter time</li> <li>Input module: Input module input response time</li> </ul> |
| Not use                             | Trigger input signal detection cycle                                                                                                                 |

- The interval for trigger input signals must be at least twice as long as the longer of either the trigger input signal detection cycle or latch cycle. If the interval is shorter than that, the signal cannot be detected correctly. If multiple trigger input signals are input before latching, the first input signal is used.

**Ex.**

If the detection cycle of the trigger input signal is the first operation cycle and the latch cycle is the second operation cycle



## Program example

The following is a program example. The touch probe start (bTouchProbe) is set to TRUE, and the actual position of Axis 1 (Axis0001) is estimated and calculated on each rising edge of the touch probe signal (G\_bTouchProbeSignal) in the motion system. After the actual position is stored in Latch position (leRecordedPosition), the Touch Probe Disabled start (bAbortTrigger) is set to TRUE and the latch operation is stopped.

### ■Axis

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### ■I/O data

| Data name      | Data category  | Data type      | Source category | Source              | Signal detection method                              |
|----------------|----------------|----------------|-----------------|---------------------|------------------------------------------------------|
| SignalData0001 | Trigger signal | MC_TRIGGER_REF | Global label    | G_bTouchProbeSignal | Detection at FALSE → TRUE (rising edge) (RisingEdge) |

### ■Global labels used

| Label name          | Data type | Comment            |
|---------------------|-----------|--------------------|
| G_bTouchProbeSignal | Bit       | Touch probe signal |

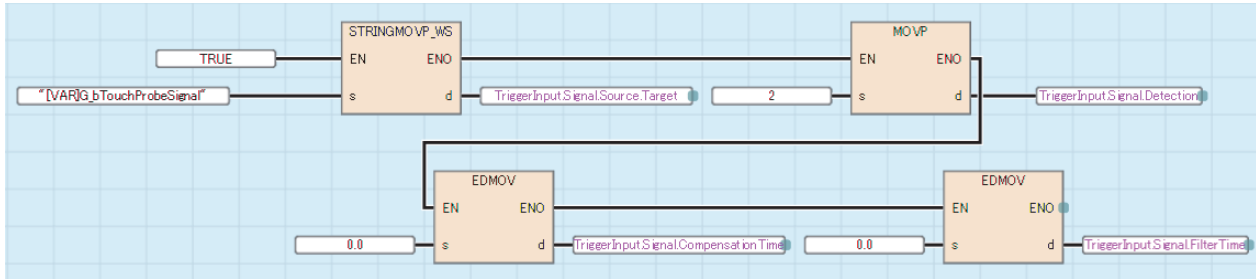
### ■Labels used

| Label name                 | Data type                           | Comment                                    |
|----------------------------|-------------------------------------|--------------------------------------------|
| MC_TouchProbe_1            | MC_TouchProbe                       | Touch Probe Enabled FB                     |
| bTouchProbe                | Bit                                 | Touch probe start                          |
| leFirstPosition            | Double-precision real number        | Lower limit position                       |
| leLastPosition             | Double-precision real number        | Upper limit position                       |
| leCompensationTime         | Double-precision real number        | Compensation time                          |
| ProbeData                  | TARGET_REF                          | Probe data                                 |
| uwRecordCount              | Word [unsigned]/bit string [16-bit] | Number of latch times                      |
| OutputBuffer               | TARGET_REF                          | Storage location of latch data             |
| bTPDone                    | Bit                                 | Touch Probe Enabled Completion             |
| bTPBusy                    | Bit                                 | Touch Probe Enabled Executing              |
| bTPCommandAborted          | Bit                                 | Touch Probe Enabled Abortion of execution  |
| bTPError                   | Bit                                 | Touch Probe Enabled Error                  |
| uwTPErrorID                | Word [unsigned]/bit string [16-bit] | Touch Probe Enabled Error code             |
| lePositionData             | Double-precision real number        | Current value monitor data                 |
| leRecordedPosition         | Double-precision real number        | Latch position                             |
| uwRecordedCounter          | Word [unsigned]/bit string [16-bit] | Number of latch times                      |
| uwTouchProbeID             | Word [unsigned]/bit string [16-bit] | Probe ID                                   |
| leLatchPos_array           | Double-precision real number(0..1)  | Variable for storing latch position        |
| MC_AbortTrigger_1          | MC_AbortTrigger                     | Touch Probe Disabled FB                    |
| bAbortTrigger              | Bit                                 | Touch Probe Disabled start                 |
| bATDone                    | Bit                                 | Touch Probe Disabled Completion            |
| bATBusy                    | Bit                                 | Touch Probe Disabled processing            |
| bATCommandAborted          | Bit                                 | Touch Probe Disabled Abortion of execution |
| bATError                   | Bit                                 | Touch Probe Disabled Error                 |
| uwATErrorID                | Word [unsigned]/bit string [16-bit] | Touch Probe Disabled Error code            |
| TriggerInput <sup>*1</sup> | MC_TRIGGER_REF                      | Trigger input signal                       |

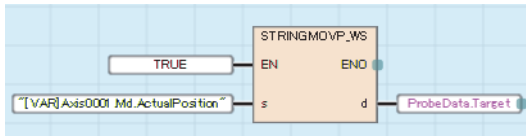
\*1 Only used in FBD/LD programs. (Required to use the I/O data in FBD/LD programs.)

## ■FBD/LD program

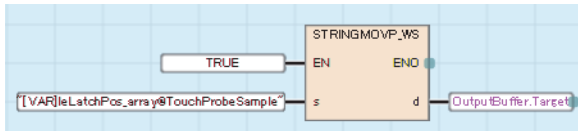
- Trigger input signal (I/O data)



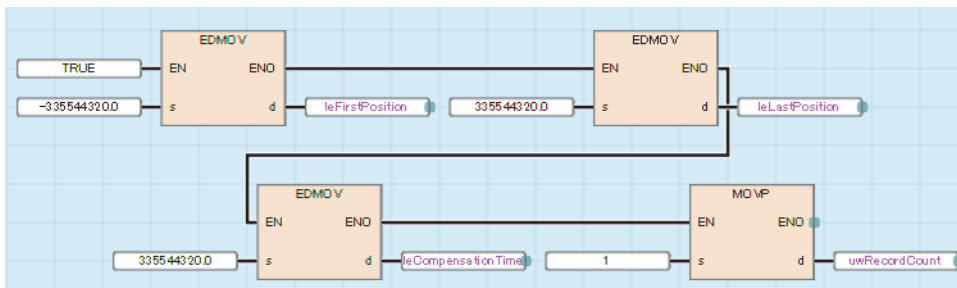
- Data for latch target



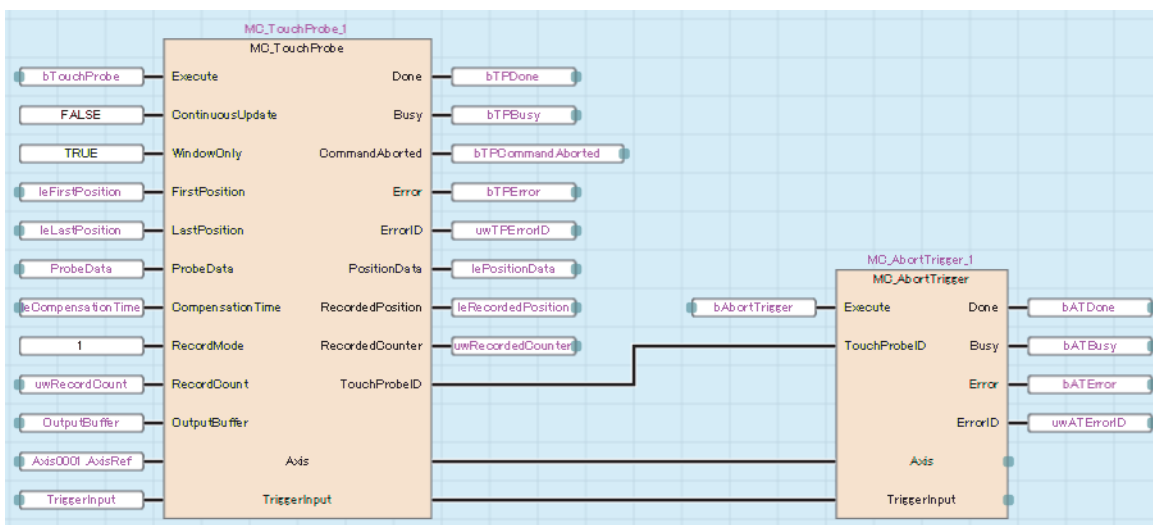
- Touch probe processing



- Data setting for touch probe



- Touch Probe Enabled/Disabled



## ■ST program

```
//-----Data for latch target-----
ProbeData.Target:= "[VAR]Axis0001.Md.ActualPosition";

//-----Touch probe processing-----
OutputBuffer.Target:= "[VAR]leLatchPos_array@TouchProbeSample";

//-----Data setting for touch probe-----
leFirstPosition:= -335544320.0;
leLastPosition:= 335544320.0;
leCompensationTime:= 0.0;
uwRecordCount:= 1;

//-----Touch Probe Enabled-----
MC_TouchProbe_1(
  Axis:= Axis0001.AxisRef ,
  TriggerInput:= SignalData0001 ,
  Execute:= bTouchProbe ,
  ContinuousUpdate:= FALSE ,
  WindowOnly:= TRUE ,
  FirstPosition:= leFirstPosition ,
  LastPosition:= leLastPosition ,
  ProbeData:= ProbeData ,
  CompensationTime:= leCompensationTime ,
  RecordMode:= MC_RECORD_MODE__RecordCount ,
  RecordCount:= uwRecordCount ,
  OutputBuffer:= OutputBuffer ,
  Done=> bTPDone ,
  Busy=> bTPBusy ,
  CommandAborted=> bTPCommandAborted ,
  Error=> bTPErrors ,
  ErrorID=> uwTPErrorsID ,
  PositionData=> lePositionData ,
  RecordedPosition=> leRecordedPosition ,
  RecordedCounter=> uwRecordedCounter ,
  TouchProbeID=> uwTouchProbeID
);

//-----Touch Probe Disabled-----
MC_AbortTrigger_1(
  Axis:= Axis0001.AxisRef ,
  TriggerInput:= SignalData0001 ,
  Execute:= bAbortTrigger ,
  TouchProbeID:= MC_TouchProbe_1.TouchProbeID ,
  Done=> bATDone ,
  Busy=> bATBusy ,
  Error=> bATErrors ,
  ErrorID=> uwATErrorsID
);
```

# 45.12 Touch Probe Disabled

## MC\_AbortTrigger

This FB disables the latch that is being executed.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                              |
|----------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_AbortTrigger(   Axis:= ?AXIS_REF? ,   TriggerInput:= ?MC_TRIGGER_REF? ,   Execute:= ?BOOL? ,   TouchProbeID:= ?WORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name                 | Data type      | Input    | Setting range | Default value     | Description                                                                                                                                                    |
|--------------|----------------------|----------------|----------|---------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information     | AXIS_REF       | At start | —             | Omission possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |
| TriggerInput | Trigger input signal | MC_TRIGGER_REF | At start | —             | Omission possible | The trigger input signal is set.<br>For details, refer to the following.<br>Page 1598 Trigger input signal (TriggerInput)                                      |

#### Input variables

| Input variable | Name           | Data type  | Input    | Setting range | Default value | Description                                                                                                                                                                                                                               |
|----------------|----------------|------------|----------|---------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute        | Start          | BOOL       | At start | TRUE, FALSE   | FALSE         | When this variable is set to TRUE, MC_AbortTrigger (Touch Probe Disabled) is executed.                                                                                                                                                    |
| TouchProbeID   | Touch probe ID | WORD(UINT) | At start | 0 to 65535    | 0             | The specific ID of the disable target touch probe is set.<br>The touch probe ID to be stored in Probe ID (TouchProbeID) that was started by Execution command (Execute) of the disable target MC_TouchProbe (Touch Probe Enabled) is set. |

#### Output variables

| Output variable | Name                 | Data type  | Default value | Description                                                                                                                                                 |
|-----------------|----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion | BOOL       | FALSE         | This variable becomes TRUE when the control is completed.                                                                                                   |
| Busy            | Executing            | BOOL       | FALSE         | This variable becomes TRUE when MC_AbortTrigger (Touch Probe Disabled) is executed.                                                                         |
| Error           | Error                | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                            |
| ErrorID         | Error code           | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used |

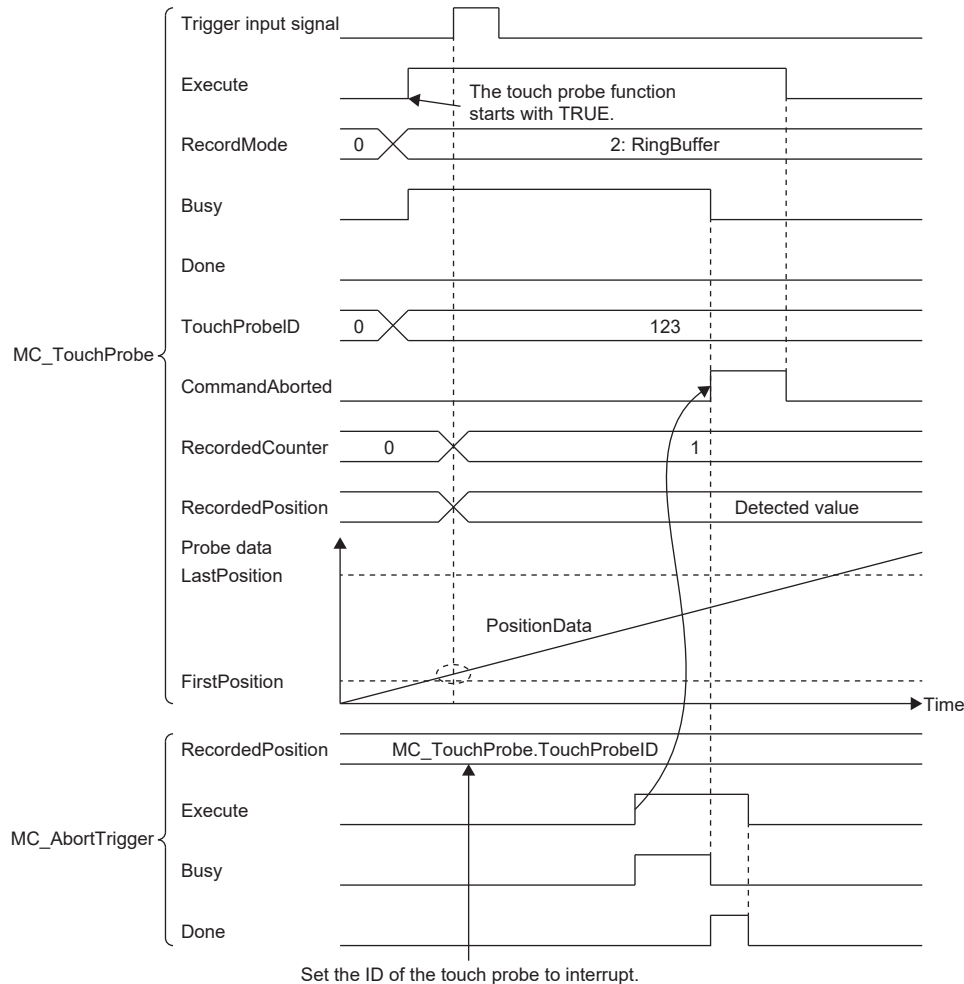
## Processing details

- This FB disables the MC\_TouchProbe (Touch Probe Enabled) set in Touch probe ID (TouchProbeID).
- When MC\_AbortTrigger (Touch Probe Disabled) is executed, if the MC\_TouchProbe (Touch Probe Enabled) set in Touch probe ID (TouchProbeID) is not in operation, Execution completion (Done) immediately becomes TRUE.
- Axis information (Axis) and Trigger input signal (TriggerInput) can be omitted, because they are ignored.

### ■ Timing chart

- When the processing is completed successfully

When Latch mode (RecordMode) is "2: Ring buffer mode (RingBuffer)"



- When the processing is completed with an error

For the timing chart, refer to the following.

📖 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■Trigger input signal (TriggerInput)

Trigger input signal is set in the MC\_TRIGGER\_REF structure. For the MC\_TARGET\_REF structure, refer to the following.

📖 Page 1487 MC\_TRIGGER\_REF

The setting range for Trigger input signal (Signal) of the MC\_TRIGGER\_REF structure set in Trigger input signal (TriggerInput) is shown below.

The type for Trigger signal (Signal) is SIGNAL\_SELECT structure. For the SIGNAL\_SELECT structure, refer to the following.

📖 Page 1492 SIGNAL\_SELECT (Signal select)

| Structure                     | Variable name                        | Type                                                       | Setting range                                                                                                                                                                                                                                    |
|-------------------------------|--------------------------------------|------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SIGNAL_SELECT (Signal select) | Source (Signal)                      | TARGET_REF<br>📖 Page 1489<br>TARGET_REF (Input signal)     | <b>■Type</b> <ul style="list-style-type: none"> <li>• BOOL</li> </ul> <b>■Data category</b> <ul style="list-style-type: none"> <li>• [VAR]</li> <li>• [DEV]</li> <li>• [CONST]</li> </ul>                                                        |
|                               | Detection (Signal detection method)  | INT<br>(MC_SIGNAL_LOGIC)<br>📖 Page 1524<br>MC_SIGNAL_LOGIC | <ul style="list-style-type: none"> <li>• 2: Detection at FALSE → TRUE (rising edge) (RisingEdge)</li> <li>• 3: Detection at TRUE → FALSE (falling edge) (FallingEdge)</li> <li>• 4: Detection at rising edge/falling edge (BothEdges)</li> </ul> |
|                               | CompensationTime (Compensation time) | LREAL                                                      | -5.0 to 5.0 [s]                                                                                                                                                                                                                                  |
|                               | FilterTime (Filter time)             | LREAL                                                      | 0.0 to 5.0 [s]                                                                                                                                                                                                                                   |



## Program example

The following is a program example. The touch probe start (bTouchProbe) is set to TRUE, and the actual position of Axis 1 (Axis0001) is estimated and calculated on each rising edge of the touch probe signal (G\_bTouchProbeSignal) in the motion system. After the actual position is stored in Latch position (leRecordedPosition), the Touch Probe Disabled start (bAbortTrigger) is set to TRUE and the latch operation is stopped.

### ■Axis

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### ■I/O data

| Data name      | Data category  | Data type      | Source category | Source              | Signal detection method                              |
|----------------|----------------|----------------|-----------------|---------------------|------------------------------------------------------|
| SignalData0001 | Trigger signal | MC_TRIGGER_REF | Global label    | G_bTouchProbeSignal | Detection at FALSE → TRUE (rising edge) (RisingEdge) |

### ■Global labels used

| Label name          | Data type | Comment            |
|---------------------|-----------|--------------------|
| G_bTouchProbeSignal | Bit       | Touch probe signal |

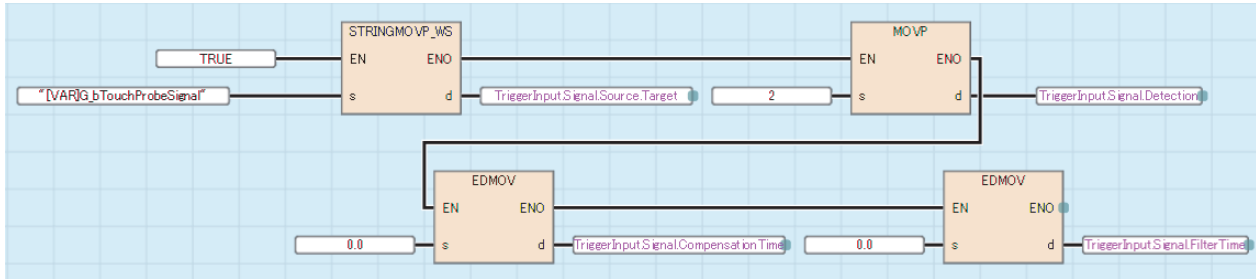
### ■Labels used

| Label name                 | Data type                           | Comment                                    |
|----------------------------|-------------------------------------|--------------------------------------------|
| MC_TouchProbe_1            | MC_TouchProbe                       | Touch Probe Enabled FB                     |
| bTouchProbe                | Bit                                 | Touch probe start                          |
| leFirstPosition            | Double-precision real number        | Lower limit position                       |
| leLastPosition             | Double-precision real number        | Upper limit position                       |
| leCompensationTime         | Double-precision real number        | Compensation time                          |
| ProbeData                  | TARGET_REF                          | Probe data                                 |
| uwRecordCount              | Word [unsigned]/bit string [16-bit] | Number of latch times                      |
| OutputBuffer               | TARGET_REF                          | Storage location of latch data             |
| bTPDone                    | Bit                                 | Touch Probe Enabled Completion             |
| bTPBusy                    | Bit                                 | Touch Probe Enabled Executing              |
| bTPCommandAborted          | Bit                                 | Touch Probe Enabled Abortion of execution  |
| bTPError                   | Bit                                 | Touch Probe Enabled Error                  |
| uwTPErrorID                | Word [unsigned]/bit string [16-bit] | Touch Probe Enabled Error code             |
| lePositionData             | Double-precision real number        | Current value monitor data                 |
| leRecordedPosition         | Double-precision real number        | Latch position                             |
| uwRecordedCounter          | Word [unsigned]/bit string [16-bit] | Number of latch times                      |
| uwTouchProbeID             | Word [unsigned]/bit string [16-bit] | Probe ID                                   |
| leLatchPos_array           | Double-precision real number(0..1)  | Variable for storing latch position        |
| MC_AbortTrigger_1          | MC_AbortTrigger                     | Touch Probe Disabled FB                    |
| bAbortTrigger              | Bit                                 | Touch Probe Disabled start                 |
| bATDone                    | Bit                                 | Touch Probe Disabled Completion            |
| bATBusy                    | Bit                                 | Touch Probe Disabled processing            |
| bATCommandAborted          | Bit                                 | Touch Probe Disabled Abortion of execution |
| bATError                   | Bit                                 | Touch Probe Disabled Error                 |
| uwATErrorID                | Word [unsigned]/bit string [16-bit] | Touch Probe Disabled Error code            |
| TriggerInput <sup>*1</sup> | MC_TRIGGER_REF                      | Trigger input signal                       |

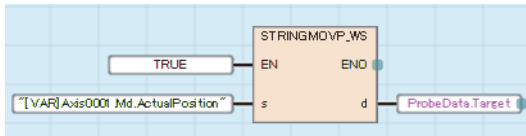
\*1 Only used in FBD/LD programs. (Required to use the I/O data in FBD/LD programs.)

## ■FBD/LD program

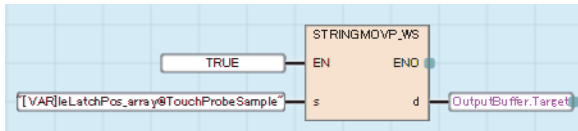
- Trigger input signal (I/O data)



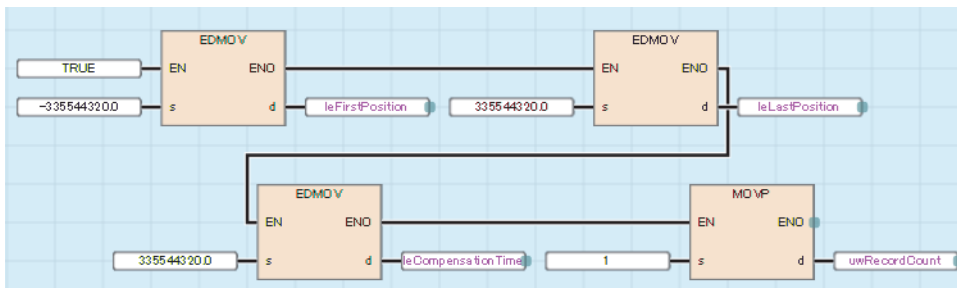
- Data for latch target



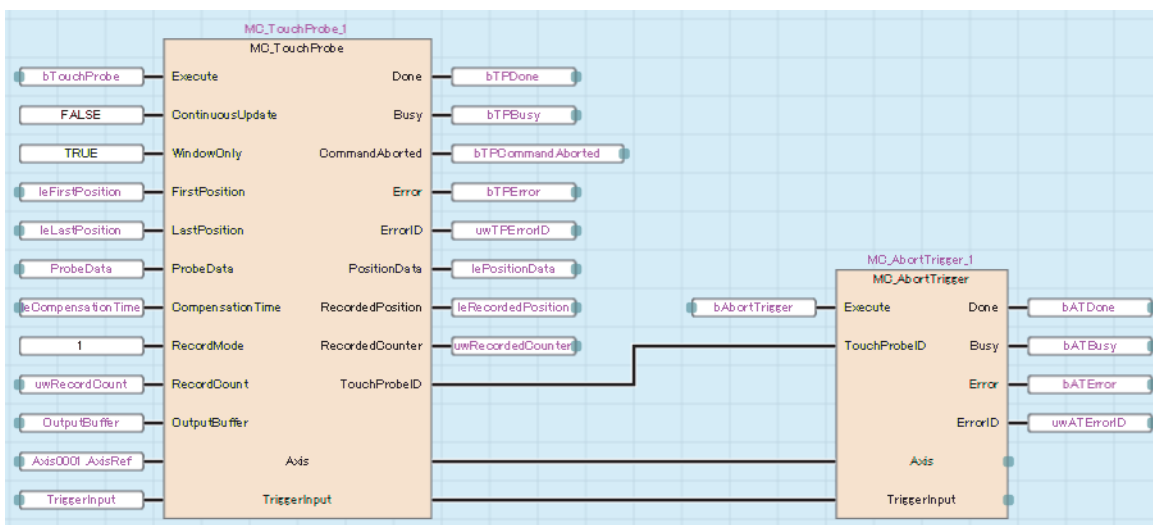
- Touch probe processing



- Data setting for touch probe



- Touch Probe Enabled/Disabled



## ■ST program

```
//-----Data for latch target-----
ProbeData.Target:= "[VAR]Axis0001.Md.ActualPosition";

//-----Touch probe processing-----
OutputBuffer.Target:= "[VAR]leLatchPos_array@TouchProbeSample";

//-----Data setting for touch probe-----
leFirstPosition:= -335544320.0;
leLastPosition:= 335544320.0;
leCompensationTime:= 0.0;
uwRecordCount:= 1;

//-----Touch Probe Enabled-----
MC_TouchProbe_1(
  Axis:= Axis0001.AxisRef ,
  TriggerInput:= SignalData0001 ,
  Execute:= bTouchProbe ,
  ContinuousUpdate:= FALSE ,
  WindowOnly:= TRUE ,
  FirstPosition:= leFirstPosition ,
  LastPosition:= leLastPosition ,
  ProbeData:= ProbeData ,
  CompensationTime:= leCompensationTime ,
  RecordMode:= MC_RECORD_MODE__RecordCount ,
  RecordCount:= uwRecordCount ,
  OutputBuffer:= OutputBuffer ,
  Done=> bTPDone ,
  Busy=> bTPBusy ,
  CommandAborted=> bTPCommandAborted ,
  Error=> bTPErrors ,
  ErrorID=> uwTPErrorsID ,
  PositionData=> lePositionData ,
  RecordedPosition=> leRecordedPosition ,
  RecordedCounter=> uwRecordedCounter ,
  TouchProbeID=> uwTouchProbeID
);

//-----Touch Probe Disabled-----
MC_AbortTrigger_1(
  Axis:= Axis0001.AxisRef ,
  TriggerInput:= SignalData0001 ,
  Execute:= bAbortTrigger ,
  TouchProbeID:= MC_TouchProbe_1.TouchProbeID ,
  Done=> bATDone ,
  Busy=> bATBusy ,
  Error=> bATErrors ,
  ErrorID=> uwATErrorsID
);
```

# 45.13 Cam Table Selection

## MC\_CamTableSelect

This FB stores the specified operation profile data (cam data) into the open area.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                              |
|----------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_CamTableSelect(   Master:= ?AXIS_REF? ,   Slave:= ?AXIS_REF? ,   CamTable:= ?MC_CAM_REF? ,   Execute:= ?BOOL? ,   Periodic:= ?BOOL? ,   MasterAbsolute:= ?BOOL? ,   SlaveAbsolute:= ?BOOL? ,   ExecutionMode:= ?INT? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   CamTableID=&gt; ?MC_CAM_ID? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name        | Data type  | Input    | Setting range | Default value         | Description                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------|-------------|------------|----------|---------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Master       | Master axis | AXIS_REF   | At start | —             | Omission possible     | When MC_CamTableSelect (Cam Table Selection) is used, I/O No. (Master.StartIO) is set. Axis No. (Master.AxisNo) is ignored.<br>Page 1444 <a href="#">AxisName.AxisRef</a> . (Axis information)                                                                                                                                                                                                                        |
| Slave        | Slave axis  | AXIS_REF   | At start | —             | Omission possible     | When MC_CamTableSelect (Cam Table Selection) is used, the setting of I/O No. (Slave.StartIO) is not required. Refer to the I/O No. set by the I/O No. (Master.StartIO). Axis No. (Slave.AxisNo) is ignored.<br>Page 1444 <a href="#">AxisName.AxisRef</a> . (Axis information)                                                                                                                                        |
| CamTable     | Cam table   | MC_CAM_REF | At start | —             | Omission not possible | The operation profile data (cam data) is set. When MC_CamTableSelect (Cam Table Selection) is executed, the setting of Profile ID (MC_CAM_ID.ProfileID) is not required. The setting value of PROFILE_DATA.ID (MC_CAM_REF.ProfileData.ID) is referred to. However, the setting of I/O No.(CamTable.ProfileData.ID.StartIO) is not required.<br>For details, refer to the following.<br>Page 1605 Cam table (CamTable) |

## Input variables

| Input variable | Name                            | Data type               | Input    | Setting range | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------|---------------------------------|-------------------------|----------|---------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute        | Start                           | BOOL                    | At start | TRUE, FALSE   | FALSE         | When this variable is set to TRUE, MC_CamTableSelect (Cam Table Selection) is executed.                                                                                                                                                                                                                                                                                                                                                     |
| Periodic       | Periodic                        | BOOL                    | At start | TRUE, FALSE   | FALSE         | The operation to execute the operation profile data (cam data) is set.<br><ul style="list-style-type: none"> <li>FALSE: Non periodic</li> <li>TRUE: Periodic</li> </ul> For details, refer to the following.<br> Page 1606 Periodic (Periodic)                                                                                                           |
| MasterAbsolute | Master axis absolute coordinate | BOOL                    | At start | FALSE         | FALSE         | The coordinate of the master axis is set.<br><ul style="list-style-type: none"> <li>FALSE: Relative coordinate</li> <li>TRUE: Setting not possible</li> </ul> For details, refer to the following.<br> Page 1606 Master axis absolute coordinate (MasterAbsolute)<br>* If set to "TRUE", Out of MasterAbsolute Range (error code: 1B94H) occurs.         |
| SlaveAbsolute  | Slave axis absolute coordinate  | BOOL                    | At start | TRUE, FALSE   | FALSE         | The coordinate of the slave axis is set.<br><ul style="list-style-type: none"> <li>FALSE: Relative coordinate</li> <li>TRUE: Absolute coordinate</li> </ul> For details, refer to the following.<br> Page 1607 Slave axis absolute coordinate (SlaveAbsolute)                                                                                            |
| ExecutionMode  | Execution mode                  | INT (MC_EXECUTION_MODE) | At start | 0, 1, 3       | 0             | The execution timing of MC_CamTableSelect (Cam Table Selection) is set.<br><ul style="list-style-type: none"> <li>0: Execute immediately (mcImmediately)</li> <li>1: Execute at completion (mcQueued)</li> <li>3: Execute speculatively (mcSpeculatively)</li> </ul> For details, refer to the following.<br> Page 1608 Execution mode (ExecutionMode) |

## Output variables

| Output variable | Name         | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                  |
|-----------------|--------------|------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Completion   | BOOL       | FALSE         | This variable becomes TRUE when the control is completed.<br>The value differs depending on the status of Start (Execute) at operation completion.<br>■When Start (Execute) is TRUE<br>This variable remains TRUE until Start (Execute) is set to FALSE.<br>■When Start (Execute) is FALSE<br>This variable becomes TRUE only for one cycle. |
| Busy            | Executing    | BOOL       | FALSE         | This variable becomes TRUE when MC_CamTableSelect (Cam Table Selection) is executed.                                                                                                                                                                                                                                                         |
| Error           | Error        | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                             |
| ErrorID         | Error code   | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                                                                              |
| CamTableID      | Cam table ID | MC_CAM_ID  | 0             | The profile ID is output.                                                                                                                                                                                                                                                                                                                    |

## Processing details

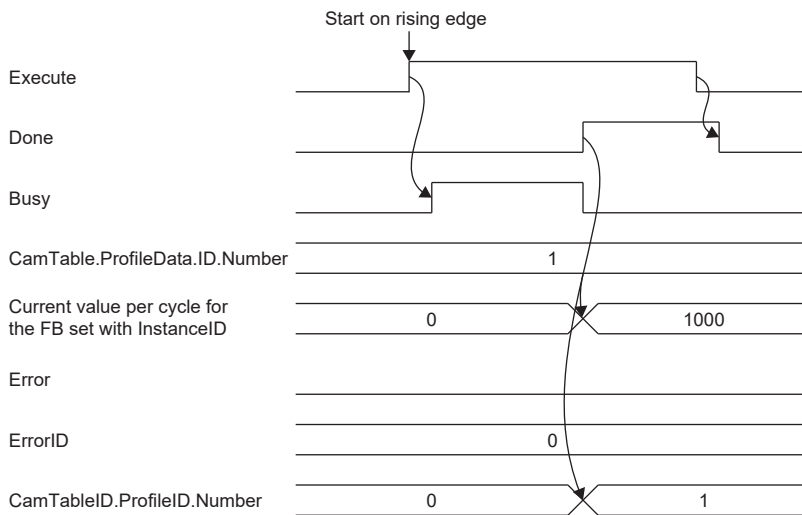
- This FB opens the operation profile data (cam data) file set in Operation profile data storage location (Location) of the PROFILE\_DATA structure to the open area by using MC\_CamTableSelect (Cam Table Selection).
- Data opened in the open area is assigned the Profile ID (Number) of the PROFILE\_ID structure.

### Point

- For details on creating operation profile data (cam data), refer to the following.  
 User's manual for the controller used
- MC\_CamTableSelect (Cam Table Selection) is performed with Motion service processing. It may take time to open depending on the processing details and the operation profile data.
- When Profile\_ID (ID) of the PROFILE\_DATA structure, Periodic (Periodic), Master axis absolute coordinate (MasterAbsolute), and Slave axis absolute coordinate (SlaveAbsolute) are present as input variables for MC\_CamTableSelect (Cam Table Selection), the file setting values are ignored and the open is performed while referencing the input variable settings. (The setting values of the file will not be overwritten.)

## ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■Cam table (CamTable)

Sets the operation profile data with the MC\_CAM\_REF type PROFILE\_DATA structure. For the PROFILE\_DATA structure, refer to the following.

📖 Page 1492 PROFILE\_DATA

References operation profile data storage location (Location) of the PROFILE\_DATA structure and performs open for the operation profile data that File name (FileName) and Folder specification (Path) indicate.

Profile ID No. (Number) of the PROFILE\_ID structure indicated by Profile ID (ID) of the PROFILE\_DATA structure is assigned in the open area.

The operation changes depending on the value set in Profile ID No. (Number).

| Profile ID No. (Number)  | Operation                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| When set to "0"          | An available ID is automatically assigned and stored in Profile ID No. (Number).<br>If an MC_CamTableSelect (Cam Table Selection) with Profile ID No. (Number) set to "0" is executed multiple times to the same operation profile data, the data will be opened in multiple different open areas.<br>When no ID is available, Insufficient Operation Profile Data ID (error code: 1BA0H) will occur and open processing will not be performed. |
| When set to "1 to 60000" | The set ID is opened without changing the ID.<br>If specifying an ID that has already been opened, the open data will be overwritten.                                                                                                                                                                                                                                                                                                           |

The relationship between the value of Profile ID No. (Number) at open and the open location area is shown below.

| Profile ID No. (Number) value                            |                                                         | Open location area                                                                                           |
|----------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Before executing MC_CamTableSelect (Cam Table Selection) | After executing MC_CamTableSelect (Cam Table Selection) |                                                                                                              |
| 0                                                        | Stores 1 to 60000                                       | New area                                                                                                     |
| 1 to 60000                                               |                                                         | Open data is overwritten if already existing.<br>When open data does not exist, a new open area is assigned. |

- For the function specific type, the same value as PROFILE\_DATA.ID (such as MC\_CAM\_REF.ProfileData.ID) is stored in the function specific type profile ID (such as MC\_CAM\_ID.ProfileID). For input variables of operation profile data control FBs (such as MC\_CamIn), set a function specific type profile ID.

For details on the profile ID type, refer to the following.

📖 User's manual for the controller used

- When executing an open FB, MC\_CAM\_REF.CamID.ProfileID does not need to be set. The set value for MC\_CAM\_REF.ProfileData.ID is referred to.

For the open FB list, refer to the following.

📖 User's manual for the controller used

- If the operation profile data set in Operation profile data storage location (Location) does not exist, No Operation Profile Data (error code: 1B8EH) occurs and the open processing is not performed.
- If the operation profile data set in Operation profile data storage location (Location) is broken or there is a problem in the format, Operation Profile Data Error (error code: 1B91H) occurs and the open processing is not performed.
- If the operation profile setting value specified in Operation profile data storage location (Location) is outside the range, Operation Profile Data Incorrect (error code: 1B8FH) occurs and the open processing is not performed.

### Ex.

If the resolution (4th row, 1st column) is outside the range, the row number in the file is stored as the data number, and the column number in the file is stored as the item number.

Detailed information 1 (Program error information)

Instance name: (FB instance name)

Detailed information 2 (Data error information)

Detail code: 1004H The operation profile data setting value is outside the range.

Data No.: 4

Item No.: 1

Data name: calc\_profile/PD00/ProfileData0001.CSV

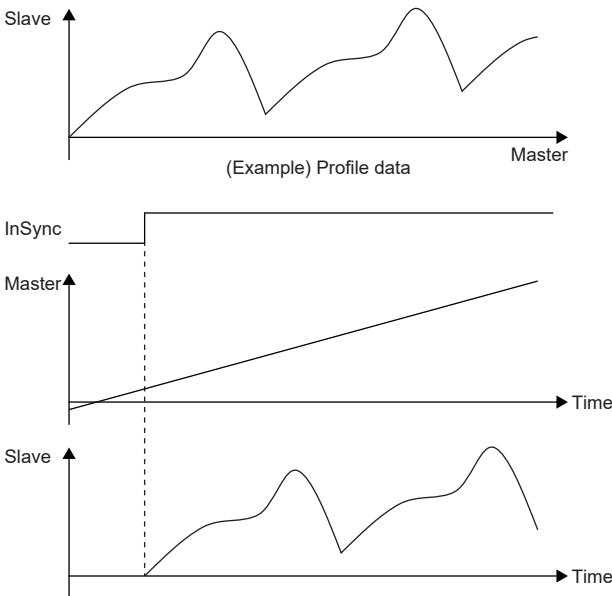
■Periodic (Periodic)

Sets the operation performed by Periodic (Periodic) at operation profile data control execution.

| Setting value        | Description                                                                          |
|----------------------|--------------------------------------------------------------------------------------|
| FALSE (Non periodic) | The control ends when it executes until the end point of the operation profile data. |
| TRUE (Periodic)      | Continuously repeats operation profile data execution.                               |

■Master axis absolute coordinate (MasterAbsolute)

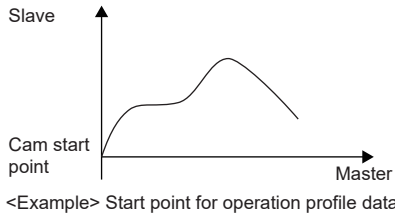
Sets the operation performed by Master axis absolute coordinate (MasterAbsolute) at operation profile data control execution.  
(When the input unit is time specification, it is ignored.)

| Setting value               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FALSE (Relative coordinate) | <p>The current Master axis (Master) value becomes the start point of the operation profile data. When In synchronization (InSync) becomes TRUE, Slave axis (Slave) is operated according to the relative movement amount of Master axis (Master).</p>  <p>The diagram consists of three vertically stacked graphs sharing a common horizontal time axis. The top graph shows the Master axis position over time, represented by a wavy line labeled '(Example) Profile data'. The middle graph shows the InSync status as a step function that transitions from FALSE to TRUE at a specific time point. The bottom graph shows the Slave axis position over time. When InSync becomes TRUE, the Slave axis starts moving according to the Master axis profile data, with its position relative to the Master axis starting at zero.</p> |
| TRUE                        | <p>Cannot be set to TRUE.</p> <p>If set to TRUE, Out of MasterAbsolute Range (error code: 1B94H) occurs.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |



# ■Slave axis absolute coordinate (SlaveAbsolute)

Sets the operation performed by Slave axis absolute coordinate (SlaveAbsolute) at operation profile data control execution.



| Setting value               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FALSE (Relative coordinate) | <p>When In synchronization (InSync) becomes TRUE, Slave axis (Slave) is operated based on the current value.</p> <p>Start point for operation profile data</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| TRUE (Absolute coordinate)  | <p>Operates so that Slave axis (Slave) at the time that In synchronization (InSync) becomes TRUE is always the start point at the start of each cycle of the operation profile data.</p> <p>When there is a limit on the value of Master axis (Master) of the operation profile data, such as the cam data length per cycle, and the start point and end point of the operation profile data are different when Periodic (Periodic) is "TRUE: Periodic", the command is output in one operation cycle to return to the first Slave axis (Slave) at the start of the next cycle.</p> <p>Start point for operation profile data</p> |

## ■Execution mode (ExecutionMode)

This variable sets the timing for executing MC\_CamTableSelect (Cam Table Selection).

| Setting value                                 | Description                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Execute immediately<br>(mcImmediately)     | The contents of the open area are immediately written.<br>The writing may affect the control in execution.<br>Note that if the operation profile data format and resolution do not match when performing open during FB execution, Operation Profile Data Being Operated (error code: 1B90H) occurs. |
| 1: Execute at completion (mcQueued)           | Opens after waiting for the FB being executed to complete.<br>When multiple FBs are waiting, the FBs will be executed in order of task priority.<br>FBs of the same priority are executed according to the start order.                                                                              |
| 3: Execute speculatively<br>(mcSpeculatively) | Operation Profile Data Being Operated (error code: 1B90H) occurs and the open area is not changed.                                                                                                                                                                                                   |

### Point

When no FB is in execution, the FB is executed immediately regardless of the setting of Execution mode (ExecutionMode).

When FBs in execution are accessing the open area, Executing (Busy) of each FB accessing the open area becomes TRUE. Use Execution mode (ExecutionMode) for the interlock as needed.

## Precautions

When rewriting the open area during control, some waveform patterns may cause the stroke value may change rapidly and apply shock to the machine. Create operation profile data so that the waveform does not become discontinuous before or after the stroke value changes.

## Program example

The following is a program example. The cam table select command (bCamTableSelect) is set to TRUE, and the operation profile data (Cam data 1) is opened to the open area and a profile ID is assigned.

### Axis

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### Operation profile data

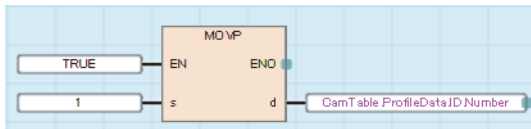
| Profile ID | Label name      | Data type  | Comment    |
|------------|-----------------|------------|------------|
| 1          | ProfileData0001 | MC_CAM_REF | Cam data 1 |

### Labels used

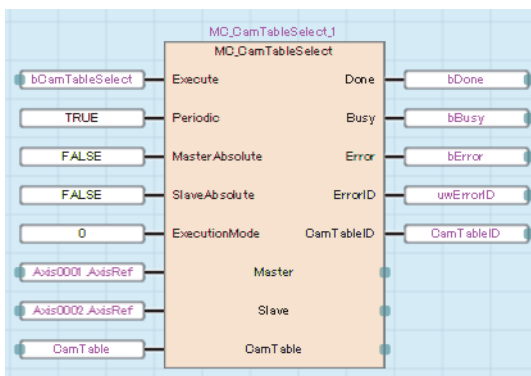
| Label name          | Data type                           | Comment                  |
|---------------------|-------------------------------------|--------------------------|
| MC_CamTableSelect_1 | MC_CamTableSelect                   | Cam Table Selection FB   |
| CamTable            | MC_CAM_REF                          | Cam table                |
| bCamTableSelect     | Bit                                 | Cam table select command |
| bDone               | Bit                                 | Execution completion     |
| bBusy               | Bit                                 | Executing                |
| bError              | Bit                                 | Error                    |
| uwErrorID           | Word [unsigned]/bit string [16-bit] | Error code               |
| CamTableID          | MC_CAM_ID                           | Cam table ID             |

### FBD/LD program

- Operation profile data (cam data) settings



- Cam Table Selection



## ■ST program

//-----Operation profile data (cam data) settings-----

CamTable.ProfileData:= ProfileData0001.ProfileData;

//-----Cam Table Selection-----

```
MC_CamTableSelect_1(  
  CamTable:= CamTable ,  
  Execute:= bCamTableSelect ,  
  Periodic:= TRUE ,  
  MasterAbsolute:= FALSE ,  
  SlaveAbsolute:= FALSE ,  
  ExecutionMode:= MC_EXECUTION_MODE__mclImmediately ,  
  Done=> bDone ,  
  Busy=> bBusy ,  
  Error=> bError ,  
  ErrorID=> uwErrorID ,  
  CamTableID=> CamTableID  
);
```

# 45.14 Current Value Change per Cycle

45

## MCv\_ChangeCycle

This FB changes the current value per cycle of the specified operation profile data control FB.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                       |
|----------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MCv_ChangeCycle(   Execute:= ?BOOL? ,   InstanceID:= ?INSTANCE_ID? ,   Cycle:= ?LREAL(0..2)? ,   Relative:= ?BOOL? ,   ExecutionMode:= ?INT? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   CancelAccepted=&gt; ?BOOL? ); </pre> |

### Setting data

#### Input variables

| Input variable | Name                    | Data type               | Input    | Setting range          | Default value | Description                                                                                                                                                                                                                                                                                                                         |
|----------------|-------------------------|-------------------------|----------|------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute        | Start                   | BOOL                    | At start | TRUE, FALSE            | FALSE         | When this variable is set to TRUE, MCv_ChangeCycle (Current Value Change per Cycle) is executed.                                                                                                                                                                                                                                    |
| InstanceID     | Instance ID             | INSTANCE_ID             | At start | 1 to 65535             | 0             | The instance ID of the operation profile data control FB whose current value per cycle will be changed is set.<br>The instance ID is valid until "PLC Ready (MotionSystem.Cd.SequenceReady)" changes from on to off.<br>When MCv_ChangeCycle (Current Value Change per Cycle) is used, set the I/O number (StartIO).                |
| Cycle          | Current value per cycle | LREAL[0..2]             | At start | —                      | 0.0           | The change target current value per cycle is set.<br>• When Relative selection (Relative) is set to FALSE, the absolute position is set.<br>• When Relative selection (Relative) is set to TRUE, the relative distance is set.<br>For details, refer to the following.<br><a href="#">Page 1613 Current value per cycle (Cycle)</a> |
| Relative       | Relative selection      | BOOL                    | At start | TRUE, FALSE            | FALSE         | The method used to change the current value per cycle is set.<br>• FALSE: Absolute coordinate<br>• TRUE: Relative distance<br>For details, refer to the following.<br><a href="#">Page 1614 Relative Selection (Relative)</a>                                                                                                       |
| ExecutionMode  | Execution mode          | INT (MC_EXECUTION_MODE) | At start | 0, 1, 3                | 0             | The execution timing of MCv_ChangeCycle (Current Value Change per Cycle) is set.<br>• 0: Execute immediately (mclmmediately)<br>For details, refer to the following.<br><a href="#">Page 1615 Execution mode (ExecutionMode)</a>                                                                                                    |
| Options        | Options                 | DWORD(HEX)              | At start | 00000000H to 00010000H | 00000000H     | The function options for MCv_ChangeCycle (Current Value Change per Cycle) are set in the specified bit position.<br>For details, refer to the following.<br><a href="#">Page 1616 Options (Options)</a>                                                                                                                             |

## ■Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                  |
|-----------------|-----------------------|------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Completion            | BOOL       | FALSE         | This variable becomes TRUE when the control is completed.<br>The value differs depending on the status of Start (Execute) at operation completion.<br>■When Start (Execute) is TRUE<br>This variable remains TRUE until Start (Execute) is set to FALSE.<br>■When Start (Execute) is FALSE<br>This variable becomes TRUE only for one cycle. |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MCv_ChangeCycle (Current Value Change per Cycle) is executed.                                                                                                                                                                                                                                                |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MCv_ChangeCycle (Current Value Change per Cycle) is aborted because of an error or multiple start.                                                                                                                                                                                              |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                             |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                                                                                |
| CancelAccepted  | Cancel acceptance     | BOOL       | FALSE         | This variable becomes TRUE when MCv_ChangeCycle (Current Value Change per Cycle) accepts the cancel.                                                                                                                                                                                                                                         |

## Processing details

- This FB changes the current value per cycle of the operation profile data control FB to the value set at execution of control.
- Sets Instance ID (InstanceID) of the public variable of an operation profile data control FB (such as MC\_CamIn) in InstanceID (InstanceID).
- Upon performing the current value per cycle change, the public variable of the operation profile data control FB (such as MC\_CamIn) changes as shown below.

| Public variable                         | Updated value                                              | Remark                                                                |
|-----------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------|
| Current value per cycle (InputPerCycle) | Value set in Current value per cycle (Cycle)               | —                                                                     |
| Reference value (Reference)             | Stroke value equivalent to Current value per cycle (Cycle) | Updates Reference value (Reference) to fix Output value (OutputData). |
| Output value (OutputData)               | No value updated                                           | —                                                                     |

### Point

Reference value (Reference) is updated to fix Output value (OutputData) when performing current value per cycle change. This occurs even when Slave axis absolute coordinate (SlaveAbsolute) of MC\_CamTableSelect (Cam Table Selection) is set to TRUE (Absolute coordinate).

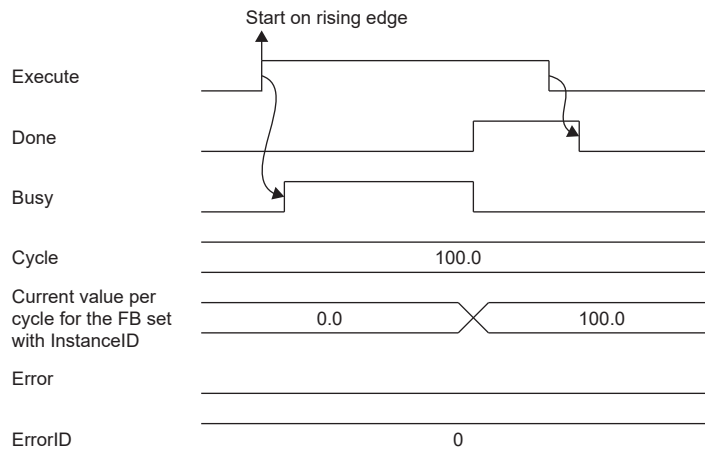
- The method for current value per cycle change is as follows.

| Method                                           | Description                                            |
|--------------------------------------------------|--------------------------------------------------------|
| MCv_ChangeCycle (Current Value Change per Cycle) | Change it to the specified value at control execution. |

- For specification of the current value per cycle to be changed, "absolute specification" or "relative specification" can be selected by Relative position selection (Relative).
- If Current value change per cycle is performed for an operation profile data control FB other than MC\_CamIn (Cam Operation Start), Current value per cycle change unsupported (error code: 1BAFH) occurs.

## ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

☞ Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■Current value per cycle (Cycle)

Sets the current value per cycle to be changed.

Values settable for Current value per cycle (Cycle) differ depending on the setting of Relative selection (Relative). Set the variable within the setting range shown below. If a value outside the range is set, MCv\_ChangeCycle Instruction Error (error code: 1BB9H) (detail code: 0001H) occurs.

| Current value per cycle (Cycle) | Setting value of Relative selection (Relative) | Setting range of Current value per cycle (Cycle)                                      |
|---------------------------------|------------------------------------------------|---------------------------------------------------------------------------------------|
| Cycle[0]                        | FALSE (Absolute position)                      | $0.0 \leq \text{Setting value} < \text{Current value per cycle}$                      |
|                                 | TRUE (Relative distance)                       | $-(\text{Cycle length}) / 2 \leq \text{Setting value} \leq (\text{Cycle length}) / 2$ |
| Cycle[1], Cycle[2]              | FALSE (Absolute position)                      | 0.0                                                                                   |
|                                 | TRUE (Relative distance)                       |                                                                                       |

## ■Relative Selection (Relative)

The value of Current value per cycle (Cycle) is changed as shown below based on the setting of Relative selection (Relative).

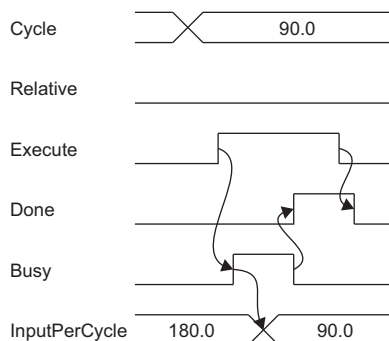
| Setting value of Relative selection (Relative) | Description                                                                                                                                                                                          |
|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FALSE (Absolute position)                      | Changes Current value per cycle (InputPerCycle) <sup>*1</sup> to a value equal to Current value per cycle (Cycle) added to the presently set Current value per cycle (InputPerCycle) <sup>*1</sup> . |
| TRUE (Relative distance)                       | Current value per cycle (InputPerCycle) <sup>*1</sup> is changed to the value of Current value per cycle (Cycle).                                                                                    |

<sup>\*1</sup> Public variable of operation profile data control FBs (such as MC\_CamIn)

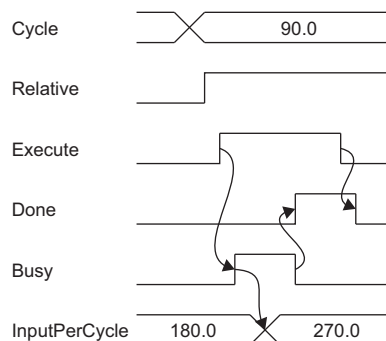
### Ex.

When public variable Current value per cycle (InputPerCycle) is "180.0" at stop, and a current value per cycle change of "90.0" is set in Current value per cycle (Cycle)

• When Relative selection (Relative) is FALSE (Absolute position)



• When Relative selection (Relative) is TRUE (Relative distance)



The following table shows whether or not exceeding the current value per cycle is possible when the current value per cycle is changed.

○: Exceeding possible, ×: Exceeding not possible

| Setting value of Relative selection (Relative) | Relationship between 1 cycle and amount moved by the current value per cycle | Exceeding Possible |
|------------------------------------------------|------------------------------------------------------------------------------|--------------------|
| FALSE (Absolute position)                      | 1 cycle > movement amount of the current value per cycle                     | ×                  |
| TRUE (Relative distance)                       | 1 cycle > movement amount of the current value per cycle                     | ○                  |
|                                                | 1 cycle ≤ movement amount of the current value per cycle                     | ○ <sup>*1</sup>    |

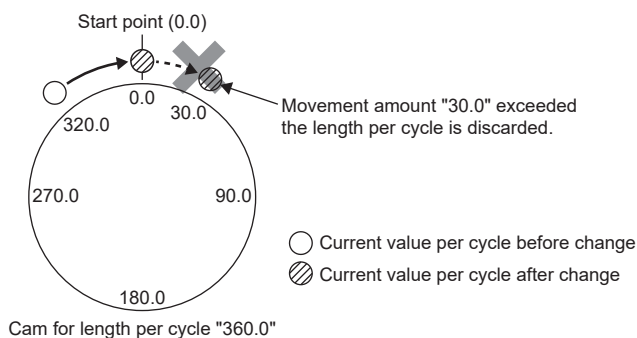
<sup>\*1</sup> The operation when exceeding occurs will differ based on the set values for Periodic (Periodic) set under MC\_CamTableSelect (Cam Table Selection)

| Setting value of Periodic (Periodic) | Description                                                 |
|--------------------------------------|-------------------------------------------------------------|
| FALSE (Non periodic)                 | Movement amount exceeding 1 cycle is disposed.              |
| TRUE (Periodic)                      | Changes the current value per cycle when exceeding 1 cycle. |

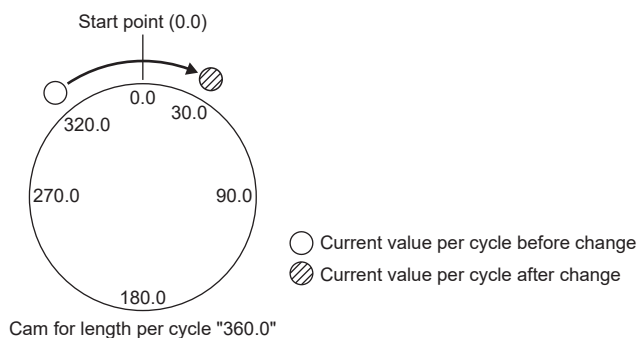
### Ex.

When the Current Value per Cycle (Cycle) changes from "320.0" to "30.0"

• When Periodic (Periodic) is FALSE (Non periodic).



• When Periodic (Periodic) is TRUE (Periodic).





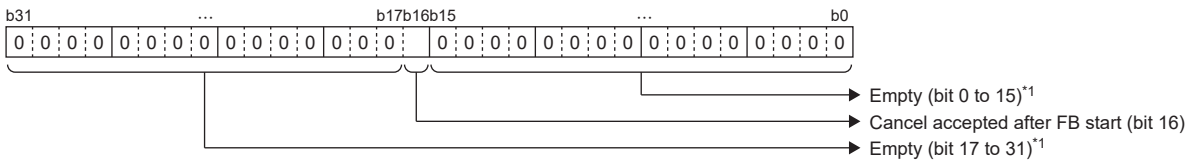
## ■Execution mode (ExecutionMode)

When MCv\_ChangeCycle (Current Value Change per Cycle) is executed, the timing for the current value per cycle change differs depending on the setting of Execution mode (ExecutionMode). The timing for Execution mode (ExecutionMode) is shown below.

| Setting value                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Execute immediately (mclImmediately) | <p>Immediately executes using Start (Execute) rising edge detection regardless of whether Executing (Busy) of the operation profile data control FB (such as MC_CamIn) is TRUE.</p> <p>&lt;Example&gt;</p> <p>When current value per cycle change is executed while Executing (Busy) of MC_CamIn (Cam Operation Start) is TRUE and "100.0" is set in Current value per cycle (Cycle) (The current value for Master axis (Master) of MC_CamIn (Cam Operation Start) is considered as not being changed.)</p> <p>The diagram shows the timing of the MC_CamIn and MCv_ChangeCycle function blocks. The MC_CamIn block is shown with its inputs and outputs. The MCv_ChangeCycle block is shown with its inputs and outputs. The diagram illustrates the timing of the execution of these function blocks and the resulting changes in the current value per cycle.</p> <p>*1 Does not change because the master axis does not move.</p> <p>*2 At current value change per cycle completion, Completion (Done) becomes TRUE and Executing (Busy) becomes FALSE.</p> <p>*3 The instance ID of the FB that executes the current value change per cycle is set manually.</p> |

■Options (Options)

The function options for MCv\_ChangeCycle (Current Value Change per Cycle) are set in the specified bit position. The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit | Name                           | Description                                                                                                                                                                                  |
|-----|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16  | Cancel accepted after FB start | Sets whether or not to allow a cancel after MCv_ChangeCycle (Current Value Change per Cycle) is executed. <ul style="list-style-type: none"><li>• 0: Disabled</li><li>• 1: Enabled</li></ul> |

- A current value per cycle change that is in standby status can be cancelled after FB execution by setting Cancel accepted after FB start.
  - The cancel is started at falling edge detection of Start (Execute).
  - The cancel is accepted only when Executing (Busy) is TRUE.
  - When the FB accepts the cancel, Cancel acceptance (CancelAccepted) becomes TRUE.
  - When the cancel is completed, Abortion of execution (CommandAborted) becomes TRUE.
  - When the cancel was performed, Current value per cycle (InputPerCycle) is not changed.

## Program example

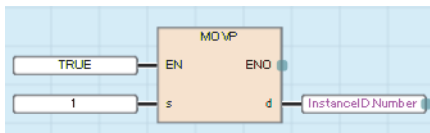
The following is a program example. The current value change per cycle command (bChangeCycle) is set to TRUE, and the current value per cycle of the Instance ID (InstanceID) set to "1" is changed to "90.0".

### Labels used

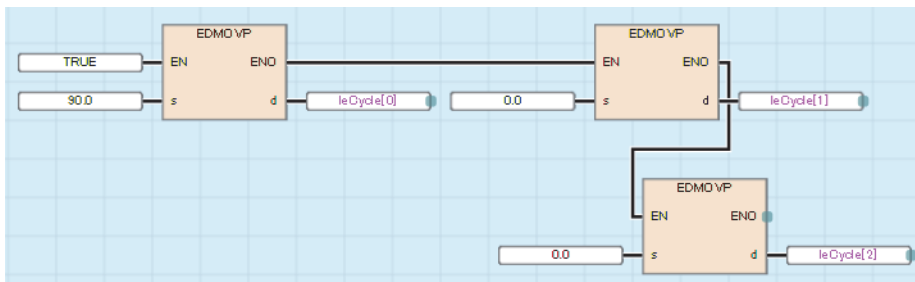
| Label name        | Data type                           | Comment                                |
|-------------------|-------------------------------------|----------------------------------------|
| MCv_ChangeCycle_1 | MCv_ChangeCycle                     | Current Value Change per Cycle FB      |
| bChangeCycle      | Bit                                 | Current value change per cycle command |
| InstanceID        | INSTANCE_ID                         | Instance ID                            |
| leCycle           | Double-precision real number(0..2)  | Current value per cycle                |
| bDone             | Bit                                 | Execution completion                   |
| bBusy             | Bit                                 | Executing                              |
| bCommandAborted   | Bit                                 | Abortion of execution                  |
| bError            | Bit                                 | Error                                  |
| uwErrorID         | Word [unsigned]/bit string [16-bit] | Error code                             |
| bCancelAccepted   | Bit                                 | Cancel acceptance                      |

### FBD/LD program

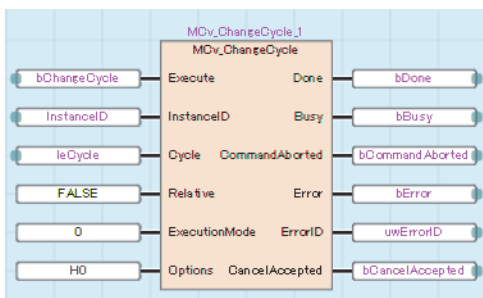
- Operation profile data setting



- Data setting for Current Value Change per Cycle



- Current Value Change per Cycle



## ■ST program

//-----Operation profile data setting-----

InstanceID.Number:= 1;

//-----Data setting for Current Value Change per Cycle-----

leCycle[0]:= 90.0;

leCycle[1]:= 0.0;

leCycle[2]:= 0.0;

//-----Current Value Change per Cycle-----

MCv\_ChangeCycle\_1(

    Execute:= bChangeCycle ,

    InstanceID:= InstanceID ,

    Cycle:= leCycle ,

    Relative:= FALSE ,

    ExecutionMode:= MC\_EXECUTION\_MODE\_\_mclmmediately ,

    Options:= H00000000 ,

    Done=> bDone ,

    Busy=> bBusy ,

    CommandAborted=> bCommandAborted ,

    Error=> bError ,

    ErrorID=> uwErrorID ,

    CancelAccepted=> bCancelAccepted

);

# 45.15 All Axes Operation Available

45

## MCv\_AllPower

This FB switches every axis to the operation available status.

| Ladder diagram | FBD/LD | ST                                                                                                                                                            |
|----------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MCv_AllPower(   Axis:= ?AXIS_REF? ,   Enable:= ?BOOL? ,   ServoON:= ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Setting range | Default value     | Description                   |
|--------------|------------------|-----------|----------|---------------|-------------------|-------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —             | Omission possible | The setting value is ignored. |

#### Input variables

| Input variable | Name             | Data type | Input  | Setting range | Default value | Description                                                                                                                                                                                |
|----------------|------------------|-----------|--------|---------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable         | Enable           | BOOL      | Always | TRUE, FALSE   | FALSE         | When this variable is set to TRUE, control of the specified axis is enabled (operation possible status).<br>When this variable is set to FALSE, control of the specified axis is disabled. |
| ServoON        | Servo ON request | BOOL      | Always | TRUE, FALSE   | FALSE         | When this variable is set to TRUE, the servo ON is requested to the specified axis.                                                                                                        |

#### Output variables

| Output variable | Name       | Data type  | Default value | Description                                                                                                                                                 |
|-----------------|------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Busy            | Executing  | BOOL       | FALSE         | This variable becomes TRUE when MCv_AllPower (All Axes Operation Available) is executed.                                                                    |
| Error           | Error      | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                            |
| ErrorID         | Error code | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used |

## Processing details

- This FB initializes the information of all axes and switches the axis status to the operation available status.
- When the Enable (Enable) and Servo ON request (ServoON) inputs are set to TRUE, every axis is switched to the operation available status.
- Starting the processing causes Executing (Busy) to become TRUE.
- When an error occurs in MCv\_AllPower (All Axes Operation Available), Error (Error) becomes TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

 User's manual for the controller used

- Inputting Enable (Enable) and Servo ON request (ServoON) switches the servo ON/OFF status and the drive unit status of the all real axes as shown below.

| Input variables |                            | Servo ON/OFF status | Driver status<br>(AxisName.Md.Driver_State) |
|-----------------|----------------------------|---------------------|---------------------------------------------|
| Enable (Enable) | Servo ON request (ServoON) |                     |                                             |
| TRUE            | TRUE                       | Servo ON            | 6: Operation Enable (OperationEnable)       |
|                 | FALSE                      | Servo OFF           | 5: Switched On (SwitchedOn)                 |
| FALSE           | TRUE                       | Servo OFF           | 3: Switched On Disabled (SwitchOnDisabled)  |
|                 | FALSE                      | Servo OFF           | 3: Switched On Disabled (SwitchOnDisabled)  |

- If the real axis is rotated by external force during the servo OFF status, follow up processing is performed.
- The servo ON/OFF control can be operated regardless of the control mode. The control mode during servo OFF depends on the specifications of the drive unit.
- MCv\_AllPower (All Axes Operation Available) is sent to the drive unit while a drive unit error is occurring, so Enable (Enable) and Servo ON request (ServoON) do not need to be turned from FALSE to TRUE again.

### Point

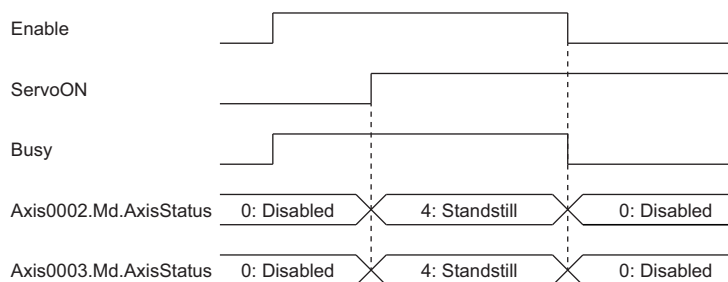
Use MCv\_AllPower (All Axes Operation Available) and MC\_Power (Operation Available) together if executing servo OFF individually.

When MCv\_AllPower (All Axes Operation Available) and MC\_Power (Operation Available) are used together, the MC\_Power (Operation Available) command is given priority.

## Timing chart

**Ex.**

When Axis 2 (Axis0002) and Axis 3 (Axis0003) are set as real drive axes



## Precautions

- For axes setting MC\_Power (Operation Available), the MC\_Power (Operation Available) command is given priority for switching to operable status.
- The servo ON/OFF status when stopping the program is maintained while Built-in motion ready (X420) is off.

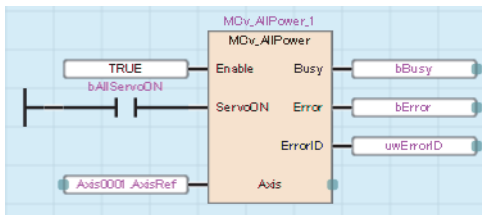
## Program example

The following is a program example. All the axes servo ON/OFF (bAllServoON) is set to TRUE, and all axes are switched to operation possible status.

### Labels used

| Label name     | Data type                           | Comment               |
|----------------|-------------------------------------|-----------------------|
| MCv_AllPower_1 | MCv_AllPower                        | All axes servo ON FB  |
| bAllServoON    | Bit                                 | All axes servo ON/OFF |
| bBusy          | Bit                                 | Executing             |
| bError         | Bit                                 | Error                 |
| uwErrorID      | Word [unsigned]/bit string [16-bit] | Error code            |

### FBD/LD program



### ST program

```

MCv_AllPower_1(
  Enable:= TRUE ,
  ServoON:= bAllServoON ,
  Busy=> bBusy ,
  Error=> bError ,
  ErrorID=> uwErrorID
);
  
```

# 45.16 Axes Group Override Value Setting

## MC\_GroupSetOverride

This FB changes the target velocity, the target acceleration, and the target deceleration of the specified axes group.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                                                          |
|----------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_GroupSetOverride(   AxesGroup:= ?AXES_GROUP_REF? ,   Enable:= ?BOOL? ,   VelFactor:= ?LREAL? ,   AccFactor:= ?LREAL? ,   JerkFactor:= ?LREAL? ,   Enabled=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name                   | Data type      | Input    | Setting range | Default value         | Description                                                                                                                                                                                                                                                                                |
|--------------|------------------------|----------------|----------|---------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxesGroup    | Axes group information | AXES_GROUP_REF | At start | —             | Omission not possible | An axes group is set.<br>When MC_GroupSetOverride (Axes Group Override Value Setting) is used, I/O No. (StartIO) is set.<br>For the variable ( <u>AxesGroupName.AxesGroupRef.</u> ) used, refer to the following.<br>Page 1468 <u>AxesGroupName.AxesGroupRef.</u> (Axes group information) |

#### Input variable

| Input variable | Name                         | Data type | Input  | Setting range       | Default value | Description                                                                                                                                                                                                                          |
|----------------|------------------------------|-----------|--------|---------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable         | Enable                       | BOOL      | Always | TRUE, FALSE         | FALSE         | When this variable is set to TRUE, MC_GroupSetOverride (Axes Group Override Value Setting) is executed.                                                                                                                              |
| VelFactor      | Velocity override factor     | LREAL     | Always | 0.00 to 10.00       | 0.00          | The velocity override factor is set.<br>When Enable (Enable) is TRUE, the value is always imported.                                                                                                                                  |
| AccFactor      | Acceleration override factor | LREAL     | Always | 0.00, 0.01 to 10.00 | 0.00          | The acceleration override factor is set.<br>When Enable (Enable) is TRUE, the value is always imported.<br>When "0.00" is set, the acceleration override factor is not changed and the control is performed with the previous value. |
| JerkFactor     | Jerk override factor         | LREAL     | Always | 0.0                 | 0.0           | "0.0" must be set.<br>* If a value other than "0.0" is set, Out of Jerk Override Coefficient (JerkFactor) Range (error code: 1BBEH) occurs.                                                                                          |

#### Output variables

| Output variable | Name       | Data type  | Default value | Description                                                                                                                                                 |
|-----------------|------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enabled         | Enabled    | BOOL       | FALSE         | This variable becomes TRUE when the override values are set correctly.                                                                                      |
| Busy            | Executing  | BOOL       | FALSE         | This variable becomes TRUE when MC_GroupSetOverride (Axes Group Override Value Setting) is executed.                                                        |
| Error           | Error      | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                            |
| ErrorID         | Error code | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used |



## Processing details

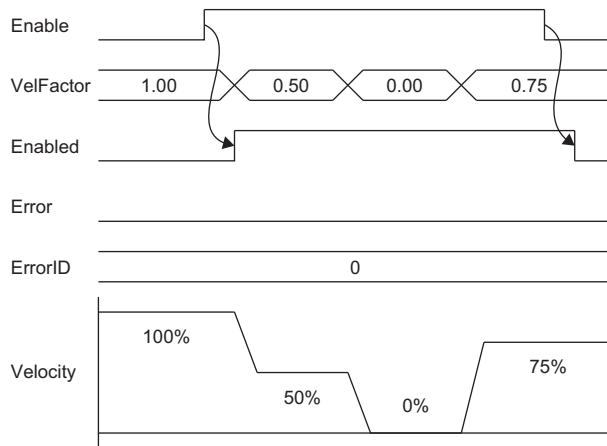
- This FB changes the target velocity, the target acceleration, and the target deceleration of the specified axes group.
- The current operating target velocity, target acceleration, and target deceleration values are changed by multiplying each value by the override factor.
- MC\_GroupSetOverride (Axes Group Override Value Setting) is executed when Enable (Enable) becomes TRUE. Enabled (Enabled) becomes TRUE while the override factor is valid.
- If the override factor value is changed while Enable (Enable) is TRUE, the new override factor is reflected.
- When an error occurs in MC\_GroupSetOverride (Axes Group Override Value Setting), Error (Error) becomes TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

 User's manual for the controller used

- When the value for Velocity override factor (VelFactor) is set to "0.00", the axis stops without Axis status (AxisName.Md.AxisStatus) changing to "4: Standby (Standstill)".
- When the value for Acceleration override factor (AccFactor) is set to "0.00", the acceleration override factor is not changed and the previous acceleration override factor is maintained.

### ■Timing chart

- When the processing is completed successfully



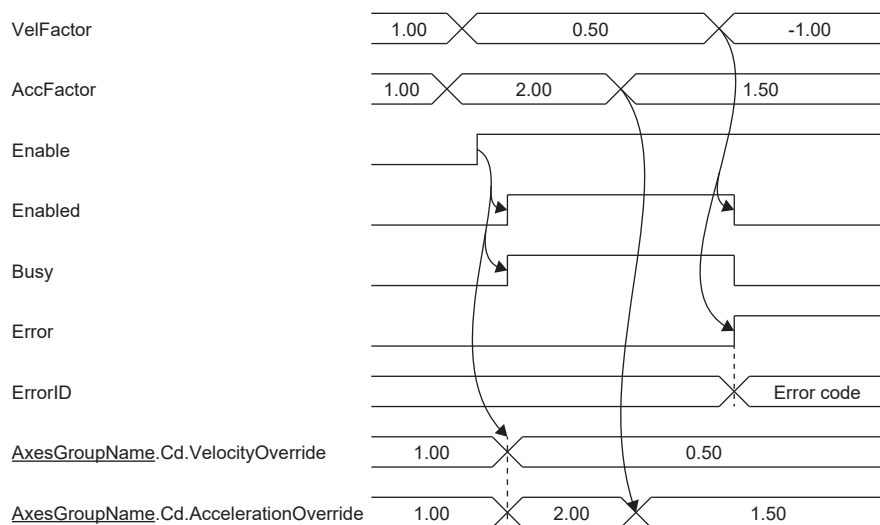
- When the processing is completed with an error

For the timing chart, refer to the following.

 Page 1435 Basic operation of Enable (Enable) type motion control FBs

## ■ Operation overview

- In MC\_GroupSetOverride (Axes Group Override Value Setting), Velocity override factor (AxesGroupName.Cd.VelocityOverride) and Acceleration override factor (AxesGroupName.Cd.AccelerationOverride) are changed.



- If the override factor is set to a value outside the range, an error will occur in MC\_GroupSetOverride (Axes Group Override Value Setting) and subsequent values will not be imported. To import values again, restart Enable (Enable).

## Precautions

- Do not assign two or more MC\_GroupSetOverride (Axes Group Override Value Setting) FBs in the same axes group. The operation is not guaranteed if two or more of this FB are set.
- For axes group control, only the override factor set with the axes group control data has an effect.
- While executing MC\_GroupSetOverride (Axes Group Override Value Setting), do not perform direct operation of Velocity override factor (AxesGroupName.Cd.VelocityOverride) and Acceleration override factor (AxesGroupName.Cd.AccelerationOverride).
- When the speed after Speed override is out of range, refer to "Velocity Range" in the following.

📖 User's manual for the controller used

- When the acceleration, deceleration, acceleration time, and deceleration time after acceleration override is out of range, refer to "Acceleration/deceleration processing function" in the following.

📖 User's manual for the controller used

## Program example

The following is a program example. The axes group override value change command (bGroupSetOverride) is set to TRUE, and the target velocity, target acceleration, and target deceleration of Axes group 1 (AxesGroup001) are changed to values multiplied by a velocity override factor of "1.0" and an acceleration override factor of "2.0".

### ■Axes group

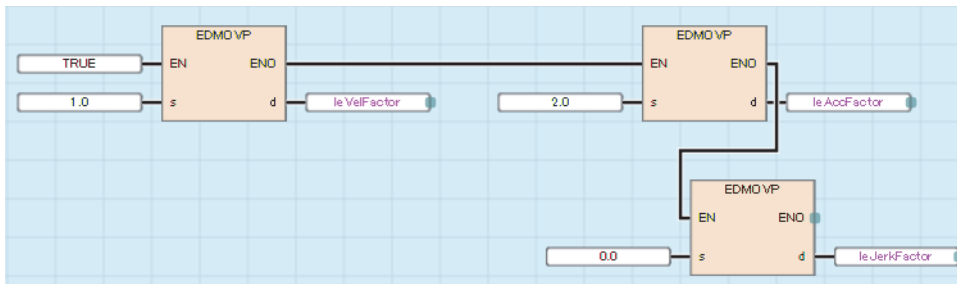
| Axes group No. | Label name   | Data type      | Comment      |
|----------------|--------------|----------------|--------------|
| 1              | AxesGroup001 | AXES_GROUP_REF | Axes group 1 |

### ■Labels used

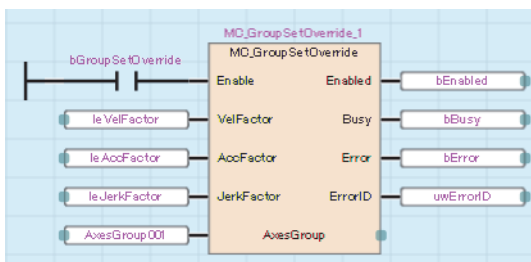
| Label name            | Data type                           | Comment                                   |
|-----------------------|-------------------------------------|-------------------------------------------|
| MC_GroupSetOverride_1 | MC_GroupSetOverride                 | Axes Group Override Value Setting FB      |
| bGroupSetOverride     | Bit                                 | Axes group override value change command  |
| leVelFactor           | Double-precision real number        | Velocity override factor                  |
| leAccFactor           | Double-precision real number        | Acceleration/deceleration override factor |
| leJerkFactor          | Double-precision real number        | Jerk override factor                      |
| bEnabled              | Bit                                 | Enabled                                   |
| bBusy                 | Bit                                 | Executing                                 |
| bError                | Bit                                 | Error                                     |
| uwErrorID             | Word [unsigned]/bit string [16-bit] | Error code                                |

### ■FBD/LD program

- Data setting for Axes Group Override Value Setting



- Axes group override value change



## ■ST program

//-----Data setting for Axes Group Override Value Setting-----

leVelFactor:= 1.00;

leAccFactor:= 2.00;

leJerkFactor:= 0.0;

//-----Axes group override value change-----

MC\_GroupSetOverride\_1(

  AxesGroup:= AxesGroup001.AxesGroupRef ,

  Enable:= bGroupSetOverride ,

  VelFactor:= leVelFactor ,

  AccFactor:= leAccFactor ,

  JerkFactor:= leJerkFactor ,

  Enabled=> bEnabled ,

  Busy=> bBusy ,

  Error=> bError ,

  ErrorID=> uwErrorID

);

# 45.17 Motion Error Reset

45

## MCv\_MotionErrorReset

This FB resets all errors and warnings of the Motion system.

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                      |
|----------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MCv_MotionErrorReset(   StartIO:= ?WORD? ,   Execute:= ?BOOL? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID:= ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name    | Data type | Input    | Setting range | Default value     | Description                                                                       |
|--------------|---------|-----------|----------|---------------|-------------------|-----------------------------------------------------------------------------------|
| StartIO      | I/O No. | WORD(HEX) | At start | 000H to 0FEH  | Omission possible | The start I/O No. (first 3 digits when displayed as 4 hexadecimal digits) is set. |

#### Input variables

| Input variable | Name              | Data type  | Input    | Setting range | Default value | Description                                                                                                      |
|----------------|-------------------|------------|----------|---------------|---------------|------------------------------------------------------------------------------------------------------------------|
| Execute        | Execution command | BOOL       | At start | TRUE, FALSE   | FALSE         | When this variable is set to TRUE, MCv_MotionErrorReset (Motion Error Reset) is executed.                        |
| Options        | Options           | DWORD(HEX) | At start | 00000000H     | 00000000H     | Set "00000000H".<br>* If a value other than "00000000H" is set, Out of Options Range (error code: 1BC3H) occurs. |

#### Output variables

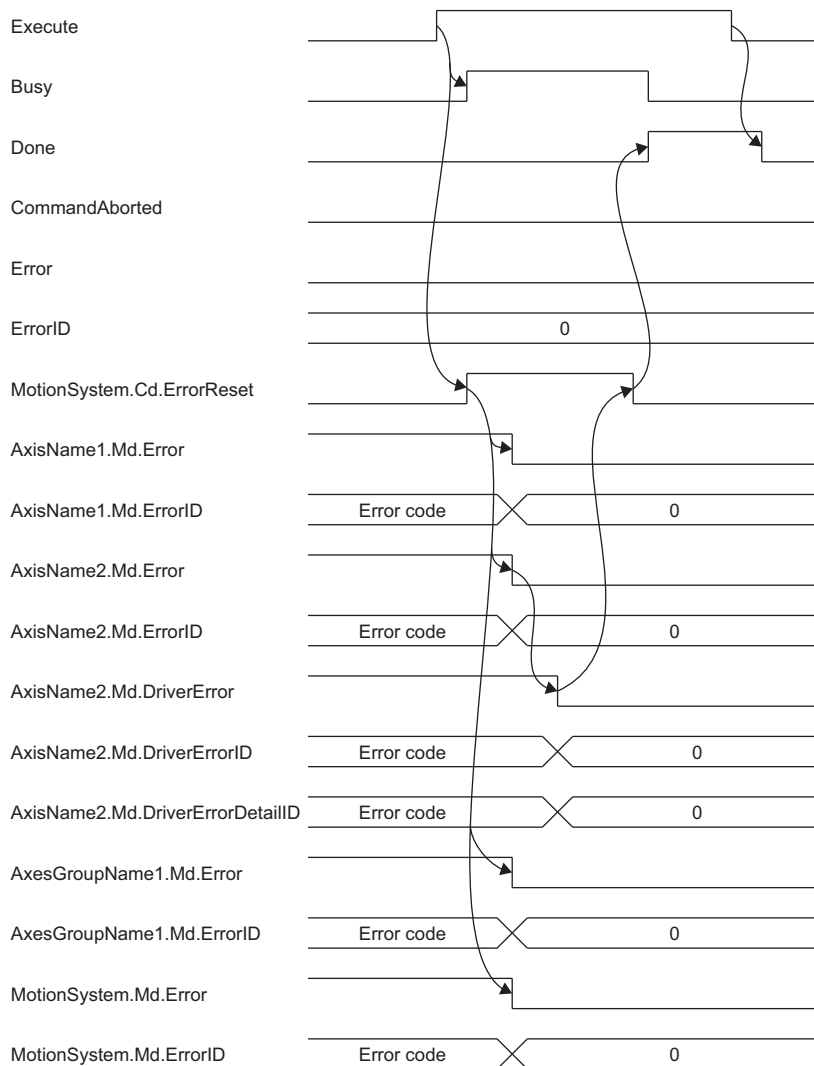
| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                               |
|-----------------|-----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when the error reset is completed.                                                                                                                             |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MCv_MotionErrorReset (Motion Error Reset) is executed.                                                                                                    |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when MCv_MotionErrorReset (Motion Error Reset) has been aborted because of timeout. The variable becomes FALSE when Execution command (Execute) becomes FALSE. |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                          |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code. For details on error codes, refer to the following.<br>User's manual for the controller used                                  |

## Processing details

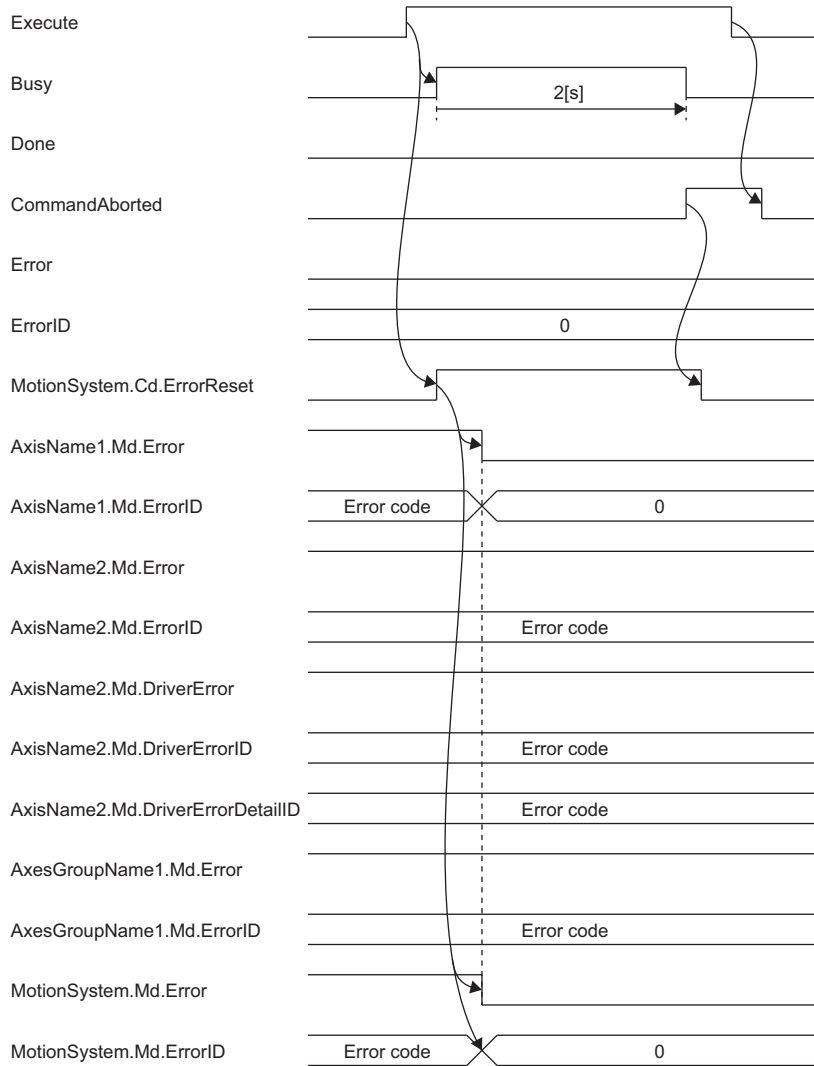
- MCv\_MotionErrorReset (Motion Error Reset) is executed when Execution command (Execute) is set to TRUE. When the processing starts, Executing (Busy) becomes TRUE and System error reset (MotionSystem.Cd.ErrorReset) also becomes TRUE.
- Once errors and warnings have been cleared for the Motion system, Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE.
- Setting Execution command (Execute) to TRUE while the causes of the errors and warnings remain does not clear the errors and warnings. In addition, if the errors are not cleared within two seconds after this FB is executed, Abortion of execution (CommandAborted) becomes TRUE and changes System error reset (MotionSystem.Cd.ErrorReset) to FALSE. Turn Execution command (Execute) to FALSE temporarily and clear the error and warning causes, then set Execution command (Execute) to TRUE again.

### ■Timing chart

- When the processing is completed successfully



- At timeout



## Precautions

- For MCv\_MotionErrorReset (Motion Error Reset), the special relay (SM0) and the special register (SD0) are not cleared, and the ERROR LED of the module is not turned off. For the execution methods of the above operations, refer to the user's manual for the controller used.
- Do not directly operate System error reset (MotionSystem.Cd.ErrorReset) while MCv\_MotionErrorReset (Motion Error Reset) is being executed.

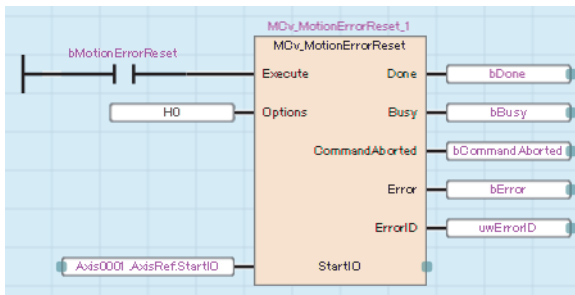
## Program example

The following is a program example. The error reset (bMotionErrorReset) is set to TRUE, and all errors and warnings of the motion system are reset.

### ■Labels used

| Label name             | Data type                           | Comment               |
|------------------------|-------------------------------------|-----------------------|
| MCv_MotionErrorReset_1 | MCv_MotionErrorReset                | Motion Error Reset FB |
| bMotionErrorReset      | Bit                                 | Error reset           |
| bDone                  | Bit                                 | Execution completion  |
| bBusy                  | Bit                                 | Executing             |
| bCommandAborted        | Bit                                 | Abortion of execution |
| bError                 | Bit                                 | Error                 |
| uwErrorID              | Word [unsigned]/bit string [16-bit] | Error code            |

### ■FBD/LD program



### ■ST program

```
MCv_MotionErrorReset_1(  
  Execute:= bMotionErrorReset ,  
  Options:= H00000000 ,  
  Done=> bDone ,  
  Busy=> bBusy ,  
  CommandAborted=> bCommandAborted ,  
  Error=> bError ,  
  ErrorID=> uwErrorID  
);
```



# 45.18 Control Operation Cycle Synchronization

45

## MCv\_SyncOperationCycles

The control operation cycle of the axis is synchronized with the specified cycle.



Before using this FB, check the versions of the controller and engineering tool.

User's manual for the controller used

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                                                             |
|----------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MCv_SyncOperationCycles(   Axis:= ?AXIS_REF? ,   ValueSource:= ?SIGNAL_SELECT? ,   Enable:= ?BOOL? ,   OperationCycle:= ?INT? ,   Options:= ?DWORD? ,   Enabled=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name                  | Data type     | Input    | Setting range | Default value         | Description                                                                                                                                                    |
|--------------|-----------------------|---------------|----------|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information      | AXIS_REF      | At start | —             | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |
| ValueSource  | Data source selection | SIGNAL_SELECT | At start | —             | Omission possible     | The input is ignored.                                                                                                                                          |

#### Input variable

| Input variable | Name                    | Data type  | Input    | Setting range | Default value | Description                                                                                                                                                  |
|----------------|-------------------------|------------|----------|---------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable         | Enable                  | BOOL       | Always   | TRUE, FALSE   | FALSE         | While this variable remains TRUE, the control operation cycle synchronization is enabled.                                                                    |
| OperationCycle | Control operation cycle | INT        | At start | 1 to 3        | 1             | The control operation cycle of the synchronization target is set.<br>• 1: First operation cycle<br>• 2: Second operation cycle<br>• 3: Third operation cycle |
| Options        | Options                 | DWORD(HEX) | At start | 00000000H     | 00000000H     | Set "00000000H".<br>An error occurs if a value other than "00000000H" is set.                                                                                |

#### Output variable

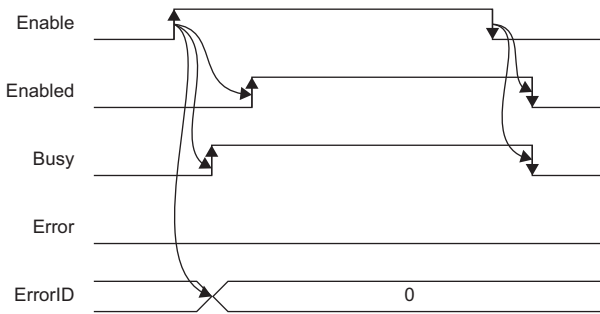
| Output variable | Name       | Data type  | Default value | Description                                                                                                                                                 |
|-----------------|------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enabled         | Enabled    | BOOL       | FALSE         | This variable becomes TRUE when the control operation cycle synchronization is operating correctly.                                                         |
| Busy            | Executing  | BOOL       | FALSE         | This variable becomes TRUE when MCv_SyncOperationCycles (Control Operation Cycle Synchronization) is being executed.                                        |
| Error           | Error      | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                            |
| ErrorID         | Error code | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used |

## Processing details

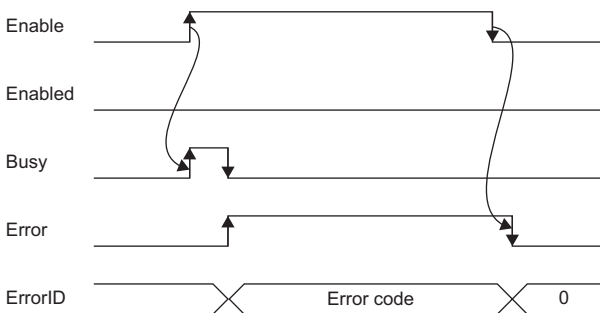
- MCv\_SyncOperationCycles (Control Operation Cycle Synchronization) synchronizes with the cycle of the value to which the control operation cycle of the selected data (axis or data source) is set.
- This function block is used if the control operation cycles of the master axis and slave axis are not the same in the single axis synchronous control FB.
- When Enable (Enable) becomes TRUE, control operation cycle synchronization is enabled. While the control operation cycle synchronization is enabled, Enabled (Enabled) is TRUE.

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error



## Precautions

- This FB synchronizes the selected data with the operation cycle during the specified control time but does not change the control operation cycle setting.
- When the control operation cycles are not the same between the input and the output (input: master axis, output: slave axis in synchronous control), start this FB before starting synchronous control. If synchronous control is started without synchronization, the operation cycle mismatch (error code: 1B29H) occurs.
- When this FB is executed, the operation time increases.
- The input argument refresh for a motion control FB is performed when the FB is read, but this FB is refreshed by the operation cycle, regardless of the FB call task (scan/fixed cycle/event).

## Program example

The following is a program example. Axes in different control cycles are synchronously controlled by using Control Operation Cycle Synchronization (MCv\_SyncOperationCycles).

This program example starts MC\_GearIn while handling Axis0001 to be controlled in the first operation cycle as the master axis and Axis0002 to be controlled in the second operation cycle as the slave axis.

The program that executes servo ON of the MR-J5-G is omitted.

### ■CC-Link IE TSN configuration

| Station No. | Type name | IP address  | Network synchronous communication setting | Communication period setting |
|-------------|-----------|-------------|-------------------------------------------|------------------------------|
| 1           | MR-J5-G   | 192.168.4.1 | Synchronize                               | Basic cycle                  |
| 2           | MR-J5-G   | 192.168.4.2 | Synchronize                               | Medium speed                 |

### ■Axes

| Axis No. | Label name | Station address setting | Axis type       | Control cycle setting                 |
|----------|------------|-------------------------|-----------------|---------------------------------------|
| 1        | Axis0001   | 192.168.4.1             | Real drive axis | Operate in the first operation cycle  |
| 2        | Axis0002   | 192.168.4.2             | Real drive axis | Operate in the second operation cycle |

### ■Labels used

| Label name                | Data type               | Comment                                    |
|---------------------------|-------------------------|--------------------------------------------|
| bSyncStart                | Bit                     | Synchronous control start                  |
| bMCGearInExecute          | Bit                     | Gear operation start                       |
| MCv_SyncOperationCycles_1 | MCv_SyncOperationCycles | Control operation cycle synchronization FB |
| MC_GearIn_1               | MC_GearIn               | Gear Operation Start FB                    |

### ■ST program

```
SET(MCv_SyncOperationCycles_1.Enabled, bMCGearInExecute);
```

```
//-----Control operation cycle synchronization-----
```

```
MCv_SyncOperationCycles_1(
```

```
    Axis:= Axis0001.AxisRef ,
```

```
//ValueSource:= ?SIGNAL_SELECT? ,//Omitted
```

```
    Enable:= bSyncStart ,
```

```
    OperationCycle:= 2 ,//2: Second operation cycle
```

```
    Options:= 0
```

```
);
```

```
//-----Gear Operation Start-----
```

```
MC_GearIn_1(
```

```
    Master:= Axis0001.AxisRef ,
```

```
    Slave:= Axis0002.AxisRef ,
```

```
    Execute:= bMCGearInExecute ,
```

```
    ContinuousUpdate:= TRUE ,
```

```
    RatioNumerator:= 1 ,
```

```
    RatioDenominator:= 1 ,
```

```
    MasterValueSource:= MC_SOURCE__mcSetValue ,
```

```
    Acceleration:= 1000.0 ,
```

```
    Deceleration:= 1000.0 ,
```

```
    Jerk:= 0.0 ,
```

```
    BufferMode:= MC_BUFFER_MODE__mcAborting ,
```

```
    Options:= 0
```

```
);
```

# 45.19 Advanced Synchronous Control One Cycle Current Position Calculation

## MCv\_AdvPositionPerCycleCalc

This FB calculates the current position per cycle based on the specified cam data.



Before using, check the versions of the controller and engineering tool.

User's manual for the controller used

| Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                         | FBD/LD                                                                                                                                                                                                                                                                                                                      | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The ladder diagram shows the function block 'Mcv_AdvPositionPerCycleCalc' with inputs: DUT: Axis, B: Execute, DUT: CamTableID, L: RingCountUpperValue, L: LengthPercycle, L: PositionPerCycle, L: StrokeAmount, L: ReferenceSetPosition, L: SetPosition, UD: StartingPoint, UD: Options. It has outputs: Axis :DUT, CalculationResult :L, Done :B, Busy :B, Error :B, ErrorID :UW. It also has 'OutputData 0' and 'InstanceID'.</p> | <p>The FBD/LD diagram shows the function block 'Mcv_AdvPositionPerCycleCalc' with inputs: Execute, CamTableID, RingCountUpperValue, LengthPercycle, PositionPerCycle, StrokeAmount, ReferenceSetPosition, SetPosition, StartingPoint, Options. It has outputs: CalculationResult, Done, Busy, Error, ErrorID, and Axis.</p> | <pre> MCv_AdvPositionPerCycleCalc(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   CamTableID:= ?MC_CAM_ID? ,   RingCountUpperValue:= ?LREAL? ,   LengthPercycle:= ?LREAL? ,   PositionPerCycle:= ?LREAL? ,   StrokeAmount:= ?LREAL? ,   ReferenceSetPosition:= ?LREAL? ,   SetPosition:= ?LREAL? ,   StartingPoint:= ?DWORD? ,   Options:= ?DWORD? ,   CalculationResult=&gt; ?LREAL? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Setting range | Default value     | Description             |
|--------------|------------------|-----------|----------|---------------|-------------------|-------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —             | Omission possible | The setting is ignored. |

#### Input variables

| Input variable       | Name                          | Data type | Input    | Setting range            | Default value | Description                                                                                                                                                                                                                                                                             |
|----------------------|-------------------------------|-----------|----------|--------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute              | Execution command             | BOOL      | At start | TRUE, FALSE              | FALSE         | This FB is executed when the value is TRUE.                                                                                                                                                                                                                                             |
| CamTableID           | Cam table ID                  | MC_CAM_ID | At start | 0 to 6000                | 0             | The operation cam table ID of the calculation target is set.<br>When "0" is set in Profile ID No. (Number) of the PROFILE_ID structure, the target is calculated as a linear cam.                                                                                                       |
| RingCountUpper Value | Ring counter upper limit      | LREAL     | At start | 0.0, 2.0 to 2147483647.0 | 0.0           | The ring counter upper limit value for the calculation target output axis is set when the ring counter upper limit is to be considered in cam position calculations.<br>When "0.0" is set, the calculation is performed with the ring counter set as "-10000000000.0 to 10000000000.0". |
| LengthPerCycle       | Cam position one cycle length | LREAL     | At start | 1.0 to 2147483647.0      | 1.0           | The length per cycle required for the cam calculation is set.                                                                                                                                                                                                                           |

| Input variable       | Name                                                | Data type  | Input    | Setting range                   | Default value | Description                                                                                                                                                                                                                                                                                             |
|----------------------|-----------------------------------------------------|------------|----------|---------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PositionPerCycle     | Cam position calculation current position per cycle | LREAL      | At start | 0.0 to 2147483647.0             | 0.0           | The current position per cycle required for the cam calculation is set.<br>When a value greater than or equal to Cam position one cycle length (LengthPerCycle) is set, the value is converted within the range of "0.0 to (Cam position one cycle length (LengthPerCycle) - 0.00001)" for calculation. |
| StrokeAmount         | Cam position calculation stroke amount              | LREAL      | At start | -2147483648.0 to 2147483647.0   | 0.0           | The cam stroke amount required for the cam calculation is set.                                                                                                                                                                                                                                          |
| ReferenceSetPosition | Cam position calculation cam reference position     | LREAL      | At start | -10000000000.0 to 10000000000.0 | 0.0           | The cam reference position required for the cam calculation is set.                                                                                                                                                                                                                                     |
| SetPosition          | Cam position calculation cam set position           | LREAL      | At start | -10000000000.0 to 10000000000.0 | 0.0           | The output axis current position required for the cam calculation is set.                                                                                                                                                                                                                               |
| StartingPoint        | Cam position calculation cam start point            | DWORD      | At start | 0 to 65535                      | 0             | This variable is set when the cam start point is to be considered in the cam calculation.                                                                                                                                                                                                               |
| Options              | Options                                             | DWORD(HEX) | At start | Fixed to 0                      | 0             | This variable cannot be set for this FB. Set 0. If a value other than 0 is set, Out of options range (error code: 1ABBH) occurs.                                                                                                                                                                        |

### ■ Output variables

| Output variable   | Name                 | Data type  | Default value | Description                                                                                                                                                                                                                                  |
|-------------------|----------------------|------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CalculationResult | Operation result     | LREAL      | 0.0           | The calculation result of the current position per cycle is stored.                                                                                                                                                                          |
| Done              | Execution completion | BOOL       | FALSE         | This variable becomes TRUE when the calculation is completed.                                                                                                                                                                                |
| Busy              | Executing            | BOOL       | FALSE         | This variable becomes TRUE when this FB is executed.                                                                                                                                                                                         |
| Error             | Error                | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                             |
| ErrorID           | Error code           | WORD(UINT) | 0             | When an error occurs, this variable returns the error code. For details on error codes, refer to the following.<br> User's manual for the controller used |

### ■ Public variables

| Public variable | Name        | Data type   | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------|-------------|-------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OutputData      | Output data | LREAL       | 0.0           | <ul style="list-style-type: none"> <li>The stroke amount corresponding to the calculation result is stored when the target is a linear cam, or when Specifying interpolation method (Interpolate) of the operation profile data is set to "0: Linear interpolation".</li> <li>The stroke ratio of the cam data corresponding to the calculation result (current position per cycle) is stored in units of percentage when Interpolation method specification of the operation profile data is set to "1: Specifying for each section" or "2: Spline interpolation", or when the data format type is set to "rotary cutter".</li> <li>The value of the output data (OutputData) is stored when Execution completion (Done) becomes TRUE.</li> </ul> |
| InstanceID      | Instance ID | INSTANCE_ID | 0             | The instance ID is stored.<br>This variable is automatically set by the system when an instance is created.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

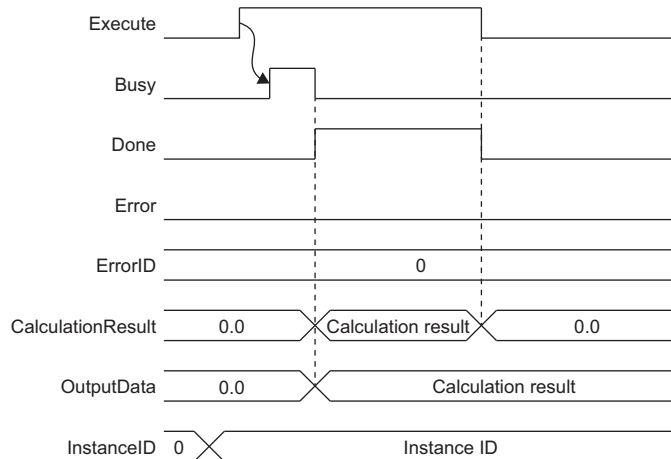
## Processing details

- The current position per cycle is calculated from cam data based on Cam position calculation cam reference position (ReferenceSetPosition) and Cam position calculation cam set position (SetPosition). The calculation result is output to Calculation result (CalculationResult).
- For details on the current position per cycle calculation, refer to the following.

 User's manual for the controller used

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## Precautions

- Before using the cam data, configure the open setting to automatically open the cam data to the open area, or open the data to the area using MC\_CamTableSelect (Cam Table Selection).
- Apply the calculation result of the current position per cycle calculation (MCv\_AdvPositionPerCycleCalc) only to MCv\_AdvancedSync (Advanced synchronous control). If the result is applied to a synchronous control FB (such as MC\_CamIn) other than MCv\_AdvancedSync (Advanced synchronous control), a mismatch occurs between the calculation result and the actual operation.
- For the current position per cycle calculation of coordinate data, the calculation result of the cam data last point may be as follows depending on the length per cycle. When coordinate data is used, matching the cam data last point with the length per cycle is recommended.

| Cam data last point               | Description                                                                                                                                                                |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Greater than the length per cycle | The calculation result may differ from the synchronous control path because the entire range of the cam data is searched regardless of the length per cycle setting value. |
| Less than the length per cycle    | The current value per cycle may be greater than the length per cycle due to the relationship between the cam set position and the cam reference position.                  |

## Program example

For a program example of this FB, refer to the following.

 User's manual for the controller used

# 45.20 Cam Set Position Calculation in Advanced Synchronous Control

45

## MCv\_AdvCamSetPositionCalc

This FB calculates the cam set position based on the specified cam data.



Before using, check the versions of the controller and engineering tool.

User's manual for the controller used

| Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | FBD/LD                                                                                                                                                                                                                                                                                                                                                                                        | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>MCv_AdvCamSetPositionCalc</p> <p>DUT: Axis                      Axis :DUT</p> <p>B: Execute                      CalculationResult :L</p> <p>DUT: CamTableID                      Done :B</p> <p>L: RingCountUpperValue                      Busy :B</p> <p>L: LengthPerCycle                      Error :B</p> <p>L: StrokeAmount                      ErrorID :UW</p> <p>L: ReferenceSetPosition</p> <p>L: PositionPerCycle</p> <p>UD: StartingPoint</p> <p>UD: Options</p> <p>InputData 0</p> <p>InstanceID</p> | <p>MCv_AdvCamSetPositionCalc</p> <p>Execute                      CalculationResult</p> <p>CamTableID                      Done</p> <p>RingCountUpperValue                      Busy</p> <p>LengthPerCycle                      Error</p> <p>StrokeAmount                      ErrorID</p> <p>ReferenceSetPosition</p> <p>PositionPerCycle</p> <p>StartingPoint</p> <p>Options</p> <p>Axis</p> | <pre> MCv_AdvCamSetPositionCalc(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   CamTableID:= ?MC_CAM_ID? ,   RingCountUpperValue:= ?LREAL? ,   LengthPerCycle:= ?LREAL? ,   StrokeAmount:= ?LREAL? ,   ReferenceSetPosition:= ?LREAL? ,   PositionPerCycle:= ?LREAL? ,   StartingPoint:= ?DWORD? ,   Options:= ?DWORD? ,   CalculationResult=&gt; ?LREAL? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

## Setting data

### I/O variables

| I/O variable | Name             | Data type | Input    | Setting range | Default value     | Description             |
|--------------|------------------|-----------|----------|---------------|-------------------|-------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —             | Omission possible | The setting is ignored. |

### Input variables

| Input variable      | Name                                   | Data type | Input    | Setting range                 | Default value | Description                                                                                                                                                                                                                                                                          |
|---------------------|----------------------------------------|-----------|----------|-------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute             | Execution command                      | BOOL      | At start | TRUE, FALSE                   | FALSE         | This FB is executed when the value is TRUE.                                                                                                                                                                                                                                          |
| CamTableID          | Cam table ID                           | MC_CAM_ID | At start | 0 to 6000                     | 0             | The operation cam table ID of the calculation target is set. When "0" is set in Profile ID No. (Number) of the PROFILE_ID structure, the target is calculated as a linear cam.                                                                                                       |
| RingCountUpperValue | Ring counter upper limit               | LREAL     | At start | 0.0, 2.0 to 2147483647.0      | 0.0           | The ring counter upper limit value for the calculation target output axis is set when the ring counter upper limit is to be considered in cam position calculations. When "0.0" is set, the calculation is performed with the ring counter set as "-10000000000.0 to 10000000000.0". |
| LengthPerCycle      | Cam position one cycle length          | LREAL     | At start | 1.0 to 2147483647.0           | 1.0           | The length per cycle required for the cam calculation is set.                                                                                                                                                                                                                        |
| StrokeAmount        | Cam position calculation stroke amount | LREAL     | At start | -2147483648.0 to 2147483647.0 | 0.0           | The cam stroke amount required for the cam calculation is set.                                                                                                                                                                                                                       |

| Input variable       | Name                                                   | Data type  | Input    | Setting range                      | Default value | Description                                                                                                                                                                                     |
|----------------------|--------------------------------------------------------|------------|----------|------------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ReferenceSetPosition | Cam position calculation<br>cam reference position     | LREAL      | At start | -10000000000.0 to<br>10000000000.0 | 0.0           | The cam reference position required for the cam calculation is set.                                                                                                                             |
| PositionPerCycle     | Cam position calculation<br>current position per cycle | LREAL      | At start | 0.0 to 2147483647.0                | 0.0           | The current position per cycle required for the cam calculation is set. Set the value within the following range.<br>0.0 to the setting value of Cam position one cycle length (LengthPerCycle) |
| StartingPoint        | Cam position calculation<br>cam start point            | DWORD      | At start | 0 to 65535                         | 0             | This variable is set when the cam start point is to be considered in the cam calculation.                                                                                                       |
| Options              | Options                                                | DWORD(HEX) | At start | Fixed to 0                         | 0             | This variable cannot be set for this FB. Set 0. If a value other than 0 is set, Out of options range (error code: 1ABBH) occurs.                                                                |

## ■Output variables

| Output variable   | Name                 | Data type  | Default value | Description                                                                                                                                                                                                                                    |
|-------------------|----------------------|------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CalculationResult | Operation result     | LREAL      | 0.0           | The calculation result of the cam set position is stored.                                                                                                                                                                                      |
| Done              | Execution completion | BOOL       | FALSE         | This variable becomes TRUE when the calculation is completed.                                                                                                                                                                                  |
| Busy              | Executing            | BOOL       | FALSE         | This variable becomes TRUE when this FB is executed.                                                                                                                                                                                           |
| Error             | Error                | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                               |
| ErrorID           | Error code           | WORD(UINT) | 0             | When an error occurs, this variable returns the error code. For details on error codes, refer to the following.<br> User's manual for the controller used |

## ■Public variables

| Public variable | Name        | Data type   | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------|-------------|-------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InputData       | Input data  | LREAL       | 0.0           | <ul style="list-style-type: none"> <li>The current position per cycle corresponding to the calculation result is stored when the target is a linear cam.</li> <li>The current position per cycle corresponding to the calculation result (cam set position) is set when Specifying interpolation method (Interpolate) of the operation profile data is set to "0: Linear interpolation".</li> <li>The resolution of the cam data corresponding to the calculation result (cam set position) is set when Interpolation method specification of the operation profile data is set to "1: Specifying for each section" or "2: Spline interpolation", or when the data format type is set to "rotary cutter".</li> <li>The value of the input data (InputData) is stored when Execution completion (Done) becomes TRUE.</li> </ul> |
| InstanceID      | Instance ID | INSTANCE_ID | 0             | The instance ID is stored.<br>This variable is automatically set by the system when an instance is created.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |



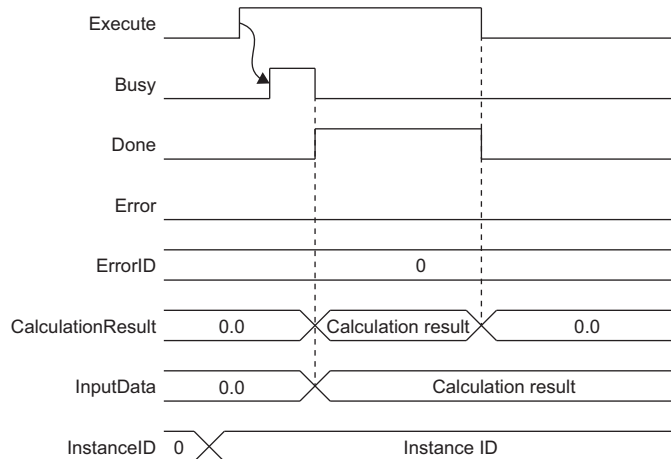
## Processing details

- The cam set position is calculated based on Cam position calculation current position per cycle (PositionPerCycle) and Cam position calculation cam reference position (ReferenceSetPosition). The calculation result is output to Calculation result (CalculationResult).
- For details on the cam set position calculation, refer to the following.

📖 User's manual for the controller used

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

📖 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## Precautions

- Before using the cam data, configure the open setting to automatically open the cam data to the open area, or open the data to the area using MC\_CamTableSelect (Cam Table Selection).
- Apply the calculation result of the cam set position calculation (MCv\_AdvCamSetPositionCalc) only to MCv\_AdvancedSync (Advanced synchronous control). If the result is applied to a synchronous control FB (such as MC\_CamIn) other than MCv\_AdvancedSync (Advanced synchronous control), a mismatch occurs between the calculation result and the actual operation.

## Program example

For a program example of this FB, refer to the following.

📖 User's manual for the controller used

# 45.21 Digital Cam Switch Output

## MC\_DigitalCamSwitch

This FB outputs the on/off signals according to a given data value.



Before using, check the versions of the controller and engineering tool.

User's manual for the controller used

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MC_DigitalCamSwitch(   Axis:= ?AXIS_REF? ,   Switches:=     ?MC_CAMSWITCH_DATA_REF? ,   Outputs:= ?MC_OUTPUT_REF? ,   TrackOptions:= ?MC_TRACK_REF?   ,Enable:= ?BOOL? ,   ValueSource:=     ?MC_CAMSWITCH_SOURCE_REF? ,   ForcedOff:= ?BOOL? ,ForcedOn:=     ?BOOL? ,   Options:= ?DWORD? ,InOperation=&gt;     ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? );         </pre> |

### Setting data

#### I/O variables

| I/O variable | Name          | Data type                                              | Input    | Setting range | Default value         | Description                                                                                                                                   |
|--------------|---------------|--------------------------------------------------------|----------|---------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis          | AXIS_REF                                               | At start | —             | Omission possible     | An axis is specified.<br>For the variable (AxisName.AxisRef.) used, refer to the following.<br>Page 1444 AxisName.AxisRef. (Axis information) |
| Switches     | Switch        | MC_CAMSWITCH_DATA_REF<br>Page 1487<br>MC_CAMSWITCH_REF | Always   | 1 to 60000    | Omission not possible | The switch is set using the operation profile data.<br>Page 1642 Switches (Switches)                                                          |
| Outputs      | Output signal | MC_OUTPUT_REF                                          | At start | —             | Omission not possible | The output signal is set.<br>For details, refer to the following.<br>Page 1642 Output signal (Outputs)                                        |
| TrackOptions | Track options | MC_TRACK_REF                                           | Always   | —             | —                     | The track options are set.<br>For details, refer to the following.<br>Page 1643 Track options (TrackOptions)                                  |

#### Input variables

| Input variable | Name                  | Data type               | Input    | Setting range | Default value | Description                                                                                                                                     |
|----------------|-----------------------|-------------------------|----------|---------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable         | Enable                | BOOL                    | Always   | TRUE, FALSE   | FALSE         | This FB is executed while the value is TRUE.                                                                                                    |
| ValueSource    | Data source selection | MC_CAMSWITCH_SOURCE_REF | At start | —             | —             | A data source is specified.<br>For details, refer to the following.<br>Page 1644 Data source selection (ValueSource)                            |
| ForcedOff      | Forced off            | BOOL                    | Always   | TRUE, FALSE   | FALSE         | The output signals are forcibly turned off while the value is TRUE.<br>For details, refer to the following.<br>Page 1645 Forced off (ForcedOff) |

| Input variable | Name      | Data type  | Input    | Setting range | Default value | Description                                                                                                                                                                                                                      |
|----------------|-----------|------------|----------|---------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ForcedOn       | Forced on | BOOL       | Always   | TRUE, FALSE   | FALSE         | The output signals are forcibly turned on while the value is TRUE.<br>For details, refer to the following.<br> Page 1645 Forced on (ForcedOn) |
| Options        | Options   | DWORD(HEX) | At start | —             | 00000000H     | The function options are set.<br>For details, refer to the following.<br> Page 1645 Options (Options)                                         |

## ■Output variables

| Output variable | Name         | Data type  | Default value | Description                                                                                                                                                                                                                                     |
|-----------------|--------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InOperation     | In operation | BOOL       | FALSE         | This variable becomes TRUE when the output signal is valid.                                                                                                                                                                                     |
| Busy            | Executing    | BOOL       | FALSE         | This variable becomes TRUE when this FB is being executed.                                                                                                                                                                                      |
| Error           | Error        | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                |
| ErrorID         | Error code   | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |

## ■Public variables

| Public variable  | Name                       | Data type   | Default value | Description                                                                                                 |
|------------------|----------------------------|-------------|---------------|-------------------------------------------------------------------------------------------------------------|
| InputsPerCycle   | Current position per cycle | LREAL       | 0             | The data source value is stored.                                                                            |
| OutputData       | Output value               | BOOL        | 0             | The output value to the output signal is stored.                                                            |
| SwitchNo         | Switch number              | WORD (UINT) | 0             | The switch number of the switch that is on is stored.                                                       |
| CurrentProfileNo | Executing profile number   | WORD (UINT) | 0             | The profile ID of the profile currently being executed is stored.                                           |
| InstanceID       | Instance ID                | INSTANCE_ID | 0             | The instance ID is stored.<br>This variable is automatically set by the system when an instance is created. |

## Processing details

This FB judges whether a data source set for Data source selection (ValueSource) satisfies the switch setting condition and outputs the output signal. For details on the digital cam switch function, refer to the following.

 User's manual for the controller used

### ■Timing chart

For the timing chart of this FB, refer to the following.

 Page 1435 Basic operation of Enable (Enable) type motion control FBs

### ■Switches (Switches)

The operation profile ID is specified with an MC\_CAMSWITCH\_DATA\_REF structure.

For the setting method, refer to the following.

 User's manual for the controller used

If Switches (Switches) is changed to outside the range during execution or an open area does not exist, a program warning (event code: 00F19H) occurs, and the operation continues with the value before the change.

### ■Output signal (Outputs)

Output signals are set with an MC\_OUTPUT\_REF structure. For details on the MC\_OUTPUT\_REF structure, refer to the following.

 Page 1487 MC\_OUTPUT\_REF

The setting range for Output signal (Outputs) of the MC\_OUTPUT\_REF structure set in Output signal (Outputs) is shown below.

The type for Output signal (Outputs) is the SIGNAL\_SELECT structure. For the SIGNAL\_SELECT structure, refer to the following.

 Page 1492 SIGNAL\_SELECT (Signal select)

| Structures                    | Variable name                                         | Type                                                                                                                                         | Setting range                                                 |
|-------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| SIGNAL_SELECT (Signal select) | Source (Signal)                                       | TARGET_REF<br> Page 1489<br>TARGET_REF (Input signal)     | ■Type<br>• BOOL<br>■Data category<br>• [LINK] <sup>*1</sup>   |
|                               | Detection (Signal detection method)                   | INT<br>(MC_SIGNAL_LOGIC)<br> Page 1524<br>MC_SIGNAL_LOGIC | The signal logic of the bit output signal cannot be selected. |
|                               | CompensationTime<br>(Compensation time) <sup>*2</sup> | LREAL                                                                                                                                        | -5.0 to 5.0 [s]                                               |
|                               | FilterTime (Filter time)                              | LREAL                                                                                                                                        | 0.0 [s] <sup>*3</sup>                                         |

\*1 When [LINK] is specified, writing to the corresponding network labels is ignored. The setting is only possible when the external signal high-accuracy output is used. For more details, check the user's manual for the controller used.

\*2 Set this variable when compensating for delays, such as those caused by the device response time. For details on time compensation, check the user's manual for the controller used.

\*3 If a value other than 0.0 is set, Out of filter time setting range of signal (error code: 1BC8H) occurs. To eliminate chattering, set Hysteresis (Switching disabled distance) of Track options (TrackOptions).

When an identical output signal is set for multiple FB instances, the logical sum of the output results is output.

The output signal is refreshed in the following timing, regardless of the program execution cycle used.

| Data category | Refresh timing                            |
|---------------|-------------------------------------------|
| [LINK]        | Communication cycle of the target station |

## ■Track options (TrackOptions)

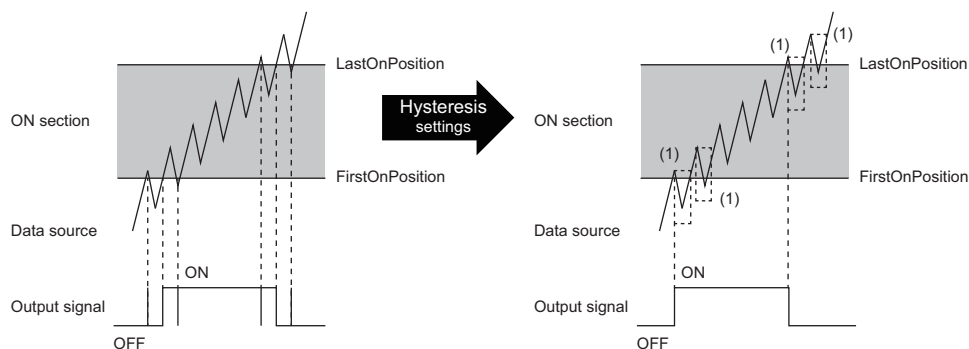
Track options are set with an MC\_TRACK\_REF structure. For the MC\_TRACK\_REF structure, refer to the following.

📖 Page 1488 MC\_TRACK\_REF

The setting range for Track options (TrackOptions) of the MC\_TRACK\_REF structure to be set for Track options (TrackOptions) is shown below.

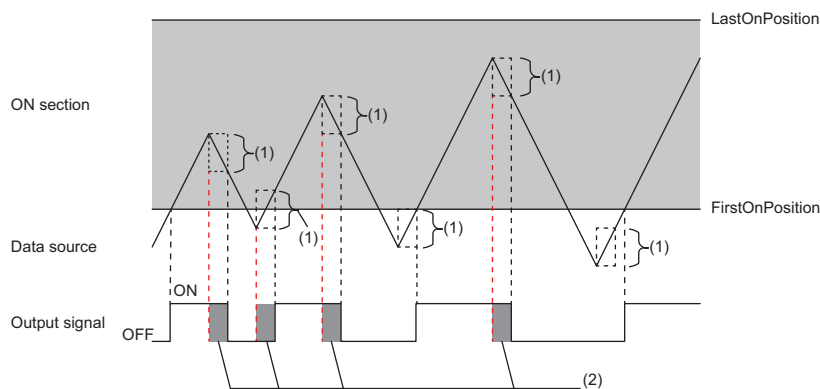
| Item                                     | Setting range        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hysteresis (Switching disabled distance) | 0.0 to 10000000000.0 | <p>Set the dead band to prevent chattering of the output signal when the speed of the data source is unstable.*1</p> <p>Use less than half of the data source ring counter range for the setting. If half or more of the data source ring counter range is used for the setting, an MC_DigitalCamSwitch instruction error (error code: 1BCAH) occurs.</p> <p>If the setting value is changed to a value outside the range during execution, a program warning (event code: 00F19H) occurs, and the operation continues with the value before the change.</p> <p>While the movement direction of the data source is within Hysteresis from the inverted position, changes in Hysteresis are not reflected to the control. The changes will be reflected to the control when out of Hysteresis.</p> |

\*1 For details, refer to the following.



(1) Hysteresis (Switching disabled distance)

- When Switch mode selection (CamSwitchMode) in the switch settings is set to "1: Position reference", the output signal is not switched between on and off within the range from the position where the data source change direction is reversed to Hysteresis (Switching disabled distance). When Direction selection (Direction) in the switch settings is set to "1: Positive Direction", the operation is as follows.



(1) Hysteresis (Switching disabled distance)

(2) The on/off switching of the output signal is not performed.

## ■Data source selection (ValueSource)

The following items are specified in the MC\_CAMSWITCH\_SOURCE\_REF structure.

- Data source
- Upper limit value and lower limit value of the data source

For details on the MC\_CAMSWITCH\_SOURCE\_REF structure, refer to the following.

📖 Page 1488 MC\_CAMSWITCH\_SOURCE\_REF

| Variable name                                                                      | Type                                                   | Setting range                                                                                                                                                                                                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source (Data source)                                                               | TARGET_REF<br>📖 Page 1489<br>TARGET_REF (Input signal) | <b>■Type</b> <ul style="list-style-type: none"> <li>• LREAL <sup>*1</sup></li> </ul> <b>■Data category</b> <ul style="list-style-type: none"> <li>• [AXIS]</li> <li>• [VAR]</li> <li>• [DEV]</li> <li>• [CONST]</li> </ul> | <p>The axis data specified by the operand axis (Axis) is referred when [AXIS] is specified for the data classification. This FB continues the control even if the target axis causes an error or is disconnected.</p> <p>When [AXIS] is specified and the current position change or home position return is executed for the target axis while this FB is being executed, an unintentional result may occur in the on/off operation of the output signal. Perform the operations mentioned above in the forced-off status, forced-on status, or while this FB is stopped.</p> <p>The axis data specified by the operand axis (Axis) is ignored when [VAR], [DEV], or [CONST] is specified for the data classification.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| RingCount_LowerValue<br>(Data source ring counter lower limit value) <sup>*2</sup> | LREAL                                                  | -10000000000.0<br>to 10000000000.0                                                                                                                                                                                         | <p>The data source ring counter range is set to fit within the range specified by the following formula.</p> $\text{RingCount\_LowerValue} \leq \text{Data source} < \text{RingCount\_UpperValue}$ <p>Set the range by referring to the data source range before (LREAL) is specified for the data type.</p> <p><b>■Setting example where INT type data is used as the data source</b><br/> RingCount_LowerValue: -32768.0<br/> RingCount_UpperValue: 32768.0</p> <p><b>■Setting example where user-defined data that can be an integer value from 0 to 99 is used</b><br/> RingCount_LowerValue: 0.0<br/> RingCount_UpperValue: 100.0</p> <p>If RingCount_LowerValue (Data source ring counter lower limit value) is equal to or greater than RingCount_UpperValue (Data source ring counter upper limit value), an MC_DigitalCamSwitch instruction error (error code: 1BCAH) occurs. If the absolute value obtained by subtracting RingCount_LowerValue (Data source ring counter lower limit value) from RingCount_UpperValue (Data source ring counter upper limit value) is less than 2, an MC_DigitalCamSwitch instruction error (error code: 1BCAH) occurs.</p> <p>Ensure that the data source movement amount per refresh cycle is less than half of the data source ring counter range. If the movement amount of the data source per refresh cycle is equal to or more than half of the data source ring counter range, the direction cannot be determined properly and output signals cannot be output at the correct timing.</p> |
| RingCount_UpperValue<br>(Data source ring counter upper limit value) <sup>*2</sup> |                                                        |                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

\*1 ON section determination is performed as the LREAL type. When specifying data that is not the LREAL type, explicitly specify (LREAL) for the data type. When (LREAL) is not specified for the data type, External signal selection string incorrect (error code: 1B05H) occurs.

\*2 When [Axis] is specified for Source (Data source), the setting value is ignored because the axis data specified by the operand axis (Axis) is referred.

Multiple FB instances can be executed simultaneously on a single data source.

The output signal is refreshed in the following timing, regardless of the program execution cycle used.

| Data classification | Refresh timing                                                                                                  |
|---------------------|-----------------------------------------------------------------------------------------------------------------|
| [VAR]               | Network label: Communication cycle of the target station<br>Other than the network label: First operation cycle |
| [DEV]               | First operation cycle                                                                                           |
| [CONST]             |                                                                                                                 |
| [AXIS]              | Communication cycle of the target station                                                                       |

### ■ Forced off (ForcedOff)

The output signal is forcibly turned off during execution.

It is controlled with higher priority than Hysteresis (Switching disabled distance) of Track options (TrackOptions)

| Forced off (ForcedOff) status | Operation                                                                                                |
|-------------------------------|----------------------------------------------------------------------------------------------------------|
| FALSE                         | The output signal is turned on/off based on the switch setting.<br>User's manual for the controller used |
| TRUE                          | The output signal is forcibly turned off.                                                                |

### ■ Forced on (ForcedOn)

The output signal is forcibly turned on during execution.

The output signal is forcibly turned on by setting Forced on (ForcedOn) to TRUE while Forced off (ForcedOff) is TRUE.

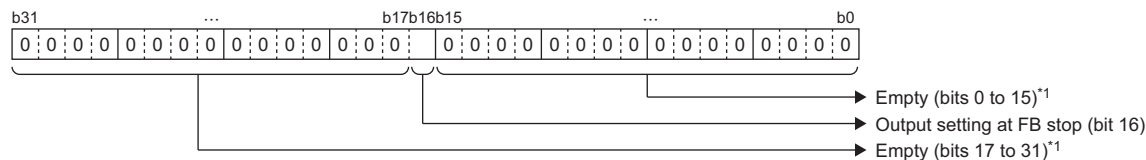
It is controlled with higher priority than Hysteresis (Switching disabled distance) of Track options (TrackOptions)

| Forced on (ForcedOn) status | Operation                                                                                                |
|-----------------------------|----------------------------------------------------------------------------------------------------------|
| FALSE                       | The output signal is turned on/off based on the switch setting.<br>User's manual for the controller used |
| TRUE                        | The output signal is forcibly turned on.                                                                 |

### ■ Options (Options)

The function options for this FB are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, an MC\_DigitalCamSwitch instruction error (error code: 1BCAH) occurs and the function does not start.

| Bit | Name                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16  | Output setting at FB stop | <p>When Enable (Enable) is changed from TRUE to FALSE, "PLC Ready (MotionSystem.Cd.SequenceReady)" is turned off, or an error occurs, set whether to hold or turn off the output signal when the FB stops.</p> <ul style="list-style-type: none"> <li>• 0: Hold</li> <li>• 1: Turn off</li> </ul> <p>The following figure shows the operation when "PLC Ready (MotionSystem.Cd.SequenceReady)" is switched during execution.</p> <p>■ Outputs: When [LINK] is specified<br/> For details on the output at controller STOP/error, refer to the following.<br/>  User's manual for the controller used<br/> Since the output to the link device RWw is held, the output hold/clear setting function of the remote I/O has priority. For details, refer to the following.<br/>  User's manual for the controller used</p> |

## Precautions

If the signal set for Output signal (Outputs) differs from Output value (OutputData), check whether the signal set for Output signal (Outputs) is manipulated by another function.



# 46 MOTION FUNCTION BLOCKS

46

## 46.1 Homing

### MC\_Home

This FB executes homing for the specified axis.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                          |
|--------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MC_Home(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   Position:= ?LREAL? ,   AbsSwitch:= ?MC_INPUT_REF? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                     |
|--------------|------------------|-----------|----------|-------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable (AxisName.AxisRef.) used, refer to the following.<br>☞ Page 1444 AxisName.AxisRef. (Axis information) |

#### Input variable

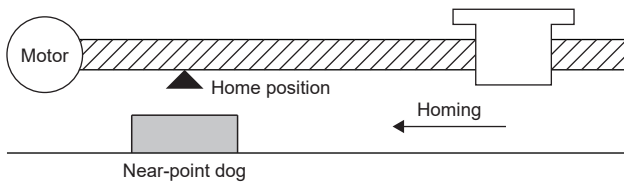
| Input variable | Name                 | Data type    | Input    | Valid range                     | Default value | Description                                                                                                                                                                                                 |
|----------------|----------------------|--------------|----------|---------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute        | Execution command    | BOOL         | At start | TRUE, FALSE                     | FALSE         | When this variable is set to TRUE, MC_Home (OPR) is executed.                                                                                                                                               |
| Position       | Target position      | LREAL        | At start | -10000000000.0 to 10000000000.0 | 0.0           | The home position address is set.<br>Set the address within the following range.<br>• -10000000000.0 ≤ Setting value < 10000000000.0<br>* When the ring counter is enabled, the ring counter range is used. |
| AbsSwitch      | Home position switch | MC_INPUT_REF | At start | —                               | —             | Sets the near-point dog signal that is transmitted to the device station in the driver homing method.<br>For details, refer to the following.<br>☞ Page 1653 Home position switch (AbsSwitch)               |
| Options        | Options              | DWORD(HEX)   | At start | 00000000H to 00010000H          | 00000000H     | The function options for MC_Home (OPR) are set in the specified bit position.<br>For details, refer to the following.<br>☞ Page 1654 Options (Options)                                                      |

## ■ Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                   |
|-----------------|-----------------------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when the homing is completed.                                                                                                                                                                                      |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MC_Home (OPR) is executed.                                                                                                                                                                                    |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MC_Home (OPR) is controlling the axis.                                                                                                                                                                       |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_Home (OPR) is aborted because of an error or multiple start.                                                                                                                                  |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                              |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |

## Processing details

- In homing, a machine home position is established. The address information stored in the motion system and drive unit is not used during this process. The position mechanically established after the homing becomes the start point, or "home position", for positioning control.



- For the homing method, "Driver homing method" and "Data set homing method" are available.  
The homing method used at homing start is determined based on the following conditions.

| Homing method          | Condition for homing method                                                                                                                                                                                                                                               |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Driver homing method   | Driver homing method is used when all of the following conditions are satisfied. <ul style="list-style-type: none"> <li>The axis type is real drive axis.</li> <li>The drive unit supports Homing mode.</li> <li>"Home offset (607CH)" is set for object data.</li> </ul> |
| Data set homing method | Data set homing method is used when the conditions listed above are not satisfied.                                                                                                                                                                                        |

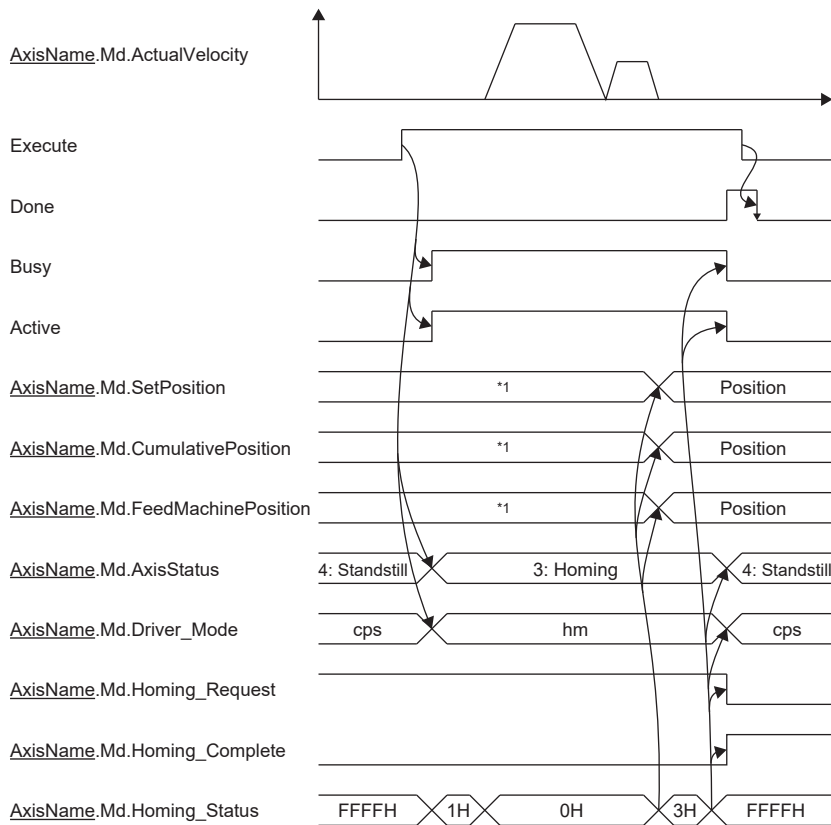
## ■Driver homing method

The control mode of the drive unit is switched to the Homing mode, and the homing is executed based on the positioning pattern set on the drive unit side.

Change the homing data of the drive unit with MC\_WriteParameter (Parameter Write) to change the homing method or the parameters. Homing operation and settable parameters depend on the specifications of the drive unit. For details on the drive unit, refer to the manual for the drive unit.

- Timing chart

- Normal operation



The value also becomes "1H" when the home position has already been established.

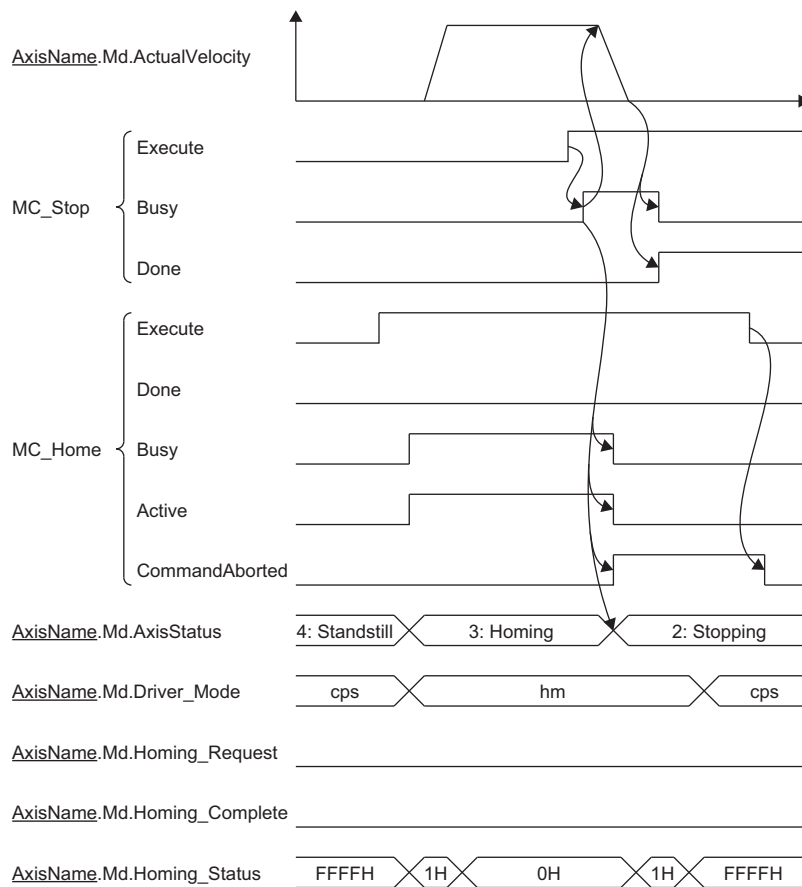
\*1 When Follow-up enabled/disabled selection (Options (Options): Bit 16) is set to "0: Follow-up disabled", it will not update during homing. When set to "1: Follow-up enabled", it will update with the current position changes during homing.

- When the operation is completed with an error

For the timing chart, refer to the following.

Page 1432 Basic operation of Execution command (Execute) type motion control FBs

- When MC\_Stop (Forced Stop) is executed



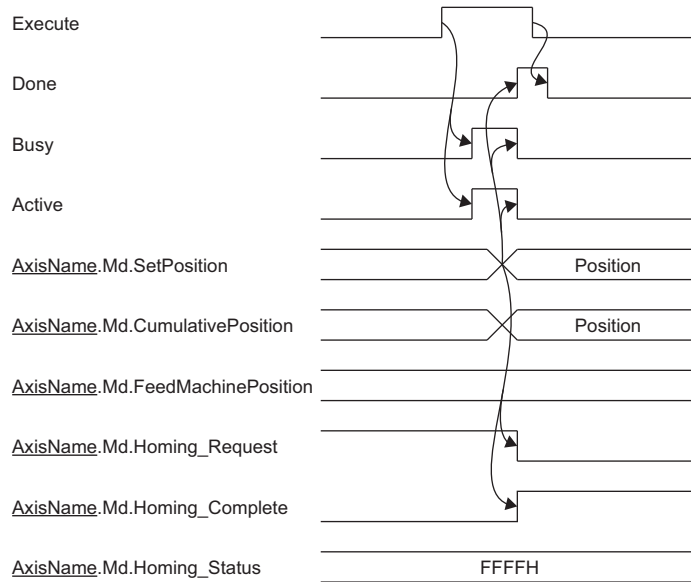
- When MC\_Stop (Forced Stop) is set to TRUE when homing, the "HALT" signal is sent to the drive unit. When using a drive unit that does not support HALT, use the forced stop signal because the drive unit does not stop with MC\_Stop (Forced Stop).
- Stop processing at homing depends on the specifications of the drive unit. Therefore, Deceleration (Deceleration) and Jerk (Jerk) of MC\_Stop (Forced Stop) are ignored.

## ■Data set homing method

Homing is executed for a virtual axis or a real axis that does not have the home position information in the device station side. The homing is completed in the Motion system, and external signals, etc. are not used. The Target position (Position) at homing is registered in the Motion system as the home position, and Command Current Position (AxisName.Md.SetPosition) and Cumulative Current Position (AxisName.Md.CumulativePosition) are rewritten to Target position (Position).

### • Timing chart

#### • Normal operation



#### • When the operation is completed with an error

For the timing chart, refer to the following.

📖 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■Homing request

- When it is necessary to execute homing, the Motion system changes Homing Request (AxisName.Md.Homing\_Request) to TRUE. Homing Request (AxisName.Md.Homing\_Request) becomes TRUE in the following cases.

- When the power supply of the system was turned on, or when a reset is performed.\*<sup>1</sup>
- When the axis type is changed.
- When homing is started. (The homing request flag will not become FALSE unless homing is completed successfully.)
- When axis driver unit conversion (numerator/denominator) is changed.
- When current position restoration is executed.
- When the absolute position data in the Motion system is erased because of a memory error or other cause.
- When the power supply of the drive unit is turned on.\*<sup>1</sup>\*<sup>2</sup>
- When "Absolute position erased" is detected on the drive unit side.\*<sup>2</sup>
- When "Polarity (607EH) (b7: position polarity)" of object data is changed\*<sup>2</sup>
- When the electronic gear is changed on the drive unit side.\*<sup>2</sup>
- When a drive unit or motor encoder change is detected.
- When it was detected that the absolute position in the scale measurement encoder is erased.\*<sup>3</sup>
- When the encoder resolution of the scale measurement encoder is changed.\*<sup>3</sup>
- When the upper limit value/lower limit value of the encoder ring counter is changed.\*<sup>4</sup>

\*<sup>1</sup> For an absolute position system, it does not become TRUE if homing is completed at reset or system/driver unit power off.

\*<sup>2</sup> Real drive axis only.

\*<sup>3</sup> Real encoder axis (via drive module) only.

\*<sup>4</sup> Virtual encoder axis only.

### Point

---

When Homing Request (AxisName.Md.Homing\_Request) becomes TRUE, it is recorded in the event history. The details can be checked in the event history.

---

- Execute a homing request clear in systems that do not require homing. Changing Homing Request Clear (AxisName.Cd.Homing\_ClearRequest) to TRUE causes Homing Request (AxisName.Md.Homing\_Request) to become FALSE.

### Point

---

Directly rewriting Homing Request (AxisName.Md.Homing\_Request) to FALSE with a program or others will not clear the homing request in the Motion system. Be sure to use Homing Request Clear (AxisName.Cd.Homing\_ClearRequest) to set the homing request to FALSE.

---

## ■Home position switch (AbsSwitch)

Sets the near-point dog signal that is transmitted to the device station in the driver homing method.

Home position switch (AbsSwitch) is set with an MC\_INPUT\_REF structure. For details on MC\_INPUT\_REF structures, refer to the following.

📖 Page 1487 MC\_INPUT\_REF

The setting range for Input signal (AbsSwitch.Signal) set in Home position switch (AbsSwitch) is shown below.

Trigger signal (TriggerInput.Signal) is SIGNAL\_SELECT structure type.

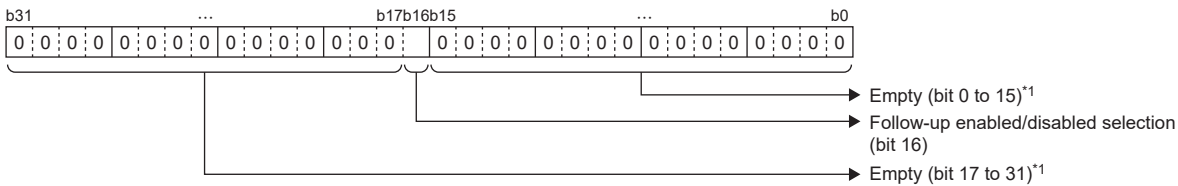
| Structure                     | Variable name                           | Type                                                       | Setting range                                                                                                                                                                                              |
|-------------------------------|-----------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SIGNAL_SELECT (Signal select) | Source (Signal)                         | TARGET_REF<br>📖 Page 1489<br>TARGET_REF (Input signal)     | <b>■Type</b> <ul style="list-style-type: none"> <li>• BOOL</li> </ul> <b>■Data category</b> <ul style="list-style-type: none"> <li>• [OBJ]</li> <li>• [VAR]</li> <li>• [DEV]</li> <li>• [CONST]</li> </ul> |
|                               | Detection (Signal detection method)     | INT<br>(MC_SIGNAL_LOGIC)<br>📖 Page 1524<br>MC_SIGNAL_LOGIC | <ul style="list-style-type: none"> <li>• 0: Detection at TRUE (HighLevel)</li> <li>• 1: Detection at FALSE (LowLevel)</li> </ul>                                                                           |
|                               | CompensationTime<br>(Compensation time) | LREAL                                                      | 0.0[s]                                                                                                                                                                                                     |
|                               | FilterTime (Filter time)                | LREAL                                                      | 0.0 to 5.0[s]                                                                                                                                                                                              |

- When [OBJ] is specified, if the target modification is omitted, the object set in the target axis specified by the operand axis (Axis) is referred. However, if the axis set to Axis (Axis) does not have a station address or a station address has not been set, External signal selection incorrect (error code: 1B31H, 1B32H, 1BD6H, or 1BD7H) will be output.
- When the station to be referred when [OBJ] is specified has the Axis Emulate function enabled and also has a set station address, the emulating object will be referred.
- When a signal that cannot be used for Signal name (AbsSwitch.Signal.Source.Target) is used, one of the following errors will be output: External signal selection string incorrect (error code: 1B05H), External signal selection incorrect (error code: 1B31H, 1B32H, 1BD6H, or 1BD7H), or Add-on Signal IO internal error (error code: 1B33H, 1BD8H).
- If a drive unit other than MELSERVO is specified as the axis, the signal specified by the home position switch cannot be transmitted as the dog signal to the drive unit.

### ■Options (Options)

The function options for MC\_Home (OPR) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". An error occurs if a value other than "0" is set.

| Bit | Name                                 | Description                                                                                                                                                                 |
|-----|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16  | Follow-up enabled/disabled selection | Enables or disables the set position follow-up during driver homing. <ul style="list-style-type: none"><li>• 0: Follow-up disabled</li><li>• 1: Follow-up enabled</li></ul> |

### Precautions

- FBs other than MC\_Stop (Forced Stop) cannot start during homing.
- The software stroke limit check for the Target position (Position) at homing start is shown below.

| Homing method          | Description                                       |
|------------------------|---------------------------------------------------|
| Driver homing method   | The software stroke limit check is not performed. |
| Data set homing method | The software stroke limit check is performed.     |

- The software stroke limit check of the start position is not performed at homing start.
- The software stroke limit is not checked during homing.
- The movement direction at homing completion is in the positive direction.



## ■Precautions for the driver homing method

- The homing cannot be started during servo OFF. Thus, the drive unit homing methods (Homing method35, 37 (Data set method)) cannot be executed during servo OFF.
- When the external signals (the hardware stroke limit specified with axis variables and the proximity dog specified with Home position switch (AbsSwitch)) are assigned, the external signals are transmitted to the drive unit. However, when the position accuracy is required in the proximity dog based (not Z-phase based) method, using the built-in DI in the drive unit is recommended.
- When Follow-up enabled/disabled selection (Options (Options): Bit 16) is set to "0: Follow-up disabled", the set position is not followed up during homing with the driver homing method. In this case, do not execute synchronous control by setting the axis that is in homing as the master axis. Doing this may cause a Velocity Range Over during Controlling (error code: 1B1AH) to occur in the slave axis.
- When Follow-up enabled/disabled selection (Options (Options): Bit 16) is set to "1: Follow-up enabled", and synchronous control is executed by setting the axis that is in homing as the master axis, the slave axis operations depending on the master axis data source selection are shown below.

| Master axis data source selection<br>(MasterValueSource)                          | Slave axis operation during synchronous control                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1: Set value (mcSetValue) 101: Latest set value (mcLatestSetValue)                | Synchronous control continues even after homing completes.                                                                                                                                                                                                                                                                                                                                                                                                        |
| 2: Actual value (mcActualValue)<br>102: Latest actual value (mcLatestActualValue) | Although the slave axis synchronizes with the master axis until homing completion, an error or alarm may occur on the drive unit side by reasons of sudden motor acceleration or an excessive command input because synchronous control is not achieved at the end. For details, refer to the manual for each drive unit.<br>For the MR-J5, the servo alarm [AL. 031.1_Servo motor speed error] or the servo alarm [AL. 035.1_Command frequency error] may occur. |

- When Homing Operation Status (AxisName.Md.Homing\_Status) is "0002H: Homing attained (target not reached)", and a stop cause occurs, the set position that has been followed up changes significantly. Therefore, an error or servo alarm may occur on the drive unit side even if "1: Set value (mcSetValue)" or "101: Latest set value (mcLatestSetValue)" is selected in Master axis data source selection (MasterValueSource). For details, refer to the manual for each drive unit.  
Example: For the MR-J5, the servo alarm ([AL.031.1 (Servo motor speed error)] or [AL. 035.1 (Command frequency error)]) may occur.
- If the following object data items are not mapped, backup is not guaranteed.

Home cycle counter (2D3DH)

Home ABS counter (2D3EH)

- The DOG signal that has been input in the servo amplifier at MR-J5(W)-G connection can be specified as the home position switch signal. For details on the setting method, refer to the following.

 User's manual for the controller used

- If the hardware stroke limit signal is detected during homing, the "HALT" signal is sent to the drive unit. To stop the operation using the limit switch signal on the drive unit side, set Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit\_Override) to "DISABLE (Check disabled)" and temporarily disable the hardware stroke limit check.
- If Hardware stroke limit override (AxisName.Cd.HwStrokeLimit\_Override) is set to "ONLY\_INSIDE (Check disabled only to inside the range direction)", Start Not Possible (error code: 1AFCH) occurs and homing is not performed.

## Program example

The following is a program example. The homing command (bHomingCMD) is set to TRUE, and homing is performed for Axis 1 (Axis0001) with Home position switch "[DEV](BOOL)D0".

### Axis

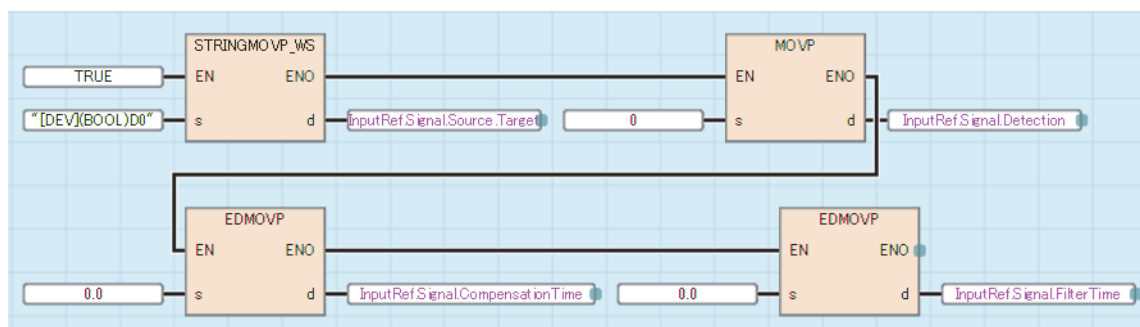
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### Labels used

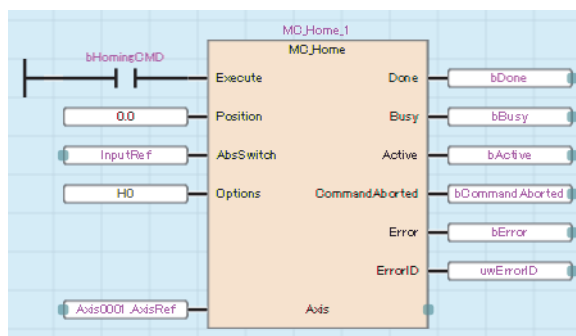
| Label name      | Data type                           | Comment               |
|-----------------|-------------------------------------|-----------------------|
| MC_Home_1       | MC_Home                             | OPR FB                |
| bHomingCMD      | Bit                                 | Homing command        |
| InputRef        | MC_INPUT_REF                        | Home position switch  |
| bDone           | Bit                                 | Execution completion  |
| bBusy           | Bit                                 | Executing             |
| bActive         | Bit                                 | Controlling           |
| bCommandAborted | Bit                                 | Abortion of execution |
| bError          | Bit                                 | Error                 |
| uwErrorID       | Word [unsigned]/bit string [16-bit] | Error code            |

### FBD/LD program

- Data setting for Home position switch



- Homing



## ■ST program

```
//-----Data setting for Home position switch-----
InputRef.Signal.Source.Target:= "[DEV](BOOL)D0";
InputRef.Signal.Detection:= MC_SIGNAL_LOGIC__HighLevel;
InputRef.Signal.CompensationTime:= 0.0;
InputRef.Signal.FilterTime:= 0.0;

//-----Homing-----
MC_Home_1(
  Axis:= Axis0001.AxisRef ,
  Execute:= bHomingCMD ,
  Position:= 0.0 ,
  AbsSwitch:= InputRef ,
  Options:= H00000000 ,
  Done=> bDone ,
  Busy=> bBusy ,
  Active=> bActive ,
  CommandAborted=> bCommandAborted ,
  Error=> bError ,
  ErrorID=> uwErrorID
);
```

## 46.2 Forced Stop

### MC\_Stop

This FB decelerates the specified axis to a stop.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                  |
|--------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MC_Stop(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                                                                                                          |
|--------------|------------------|-----------|----------|-------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br> Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable | Name              | Data type   | Input                           | Valid range                    | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------|-------------------|-------------|---------------------------------|--------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute        | Execution command | BOOL        | At start                        | TRUE, FALSE                    | FALSE         | When this variable is set to TRUE, MC_Stop (Forced Stop) is executed.                                                                                                                                                                                                                                                                                                                                                                  |
| Deceleration   | Deceleration      | LREAL       | At start/<br>Retrigger possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The deceleration is set.<br>The setting value differs depending on the acceleration/deceleration method.<br>For details, refer to "Acceleration/ deceleration processing function" in the following.<br> User's manual for the controller used<br>* The acceleration/deceleration method takes over the method specified in the on-going control. |
| Jerk           | Jerk              | LREAL       | At start/<br>Retrigger possible | 0.0                            | 0.0           | Set "0.0".<br>* If a value other than "0.0" is set, Out of Jerk Range (error code: 1A8FH) occurs.                                                                                                                                                                                                                                                                                                                                      |
| Options        | Options           | DWORD(HE X) | At start                        | 00000000H                      | 00000000H     | Set "00000000H".<br>* If a value other than "00000000H" is set, Out of Options Range (error code: 1ABBH) occurs.                                                                                                                                                                                                                                                                                                                       |

## Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                 |
|-----------------|-----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when the velocity reaches 0.                                                                                                     |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MC_Stop (Forced Stop) is executed.                                                                                          |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MC_Stop (Forced Stop) is controlling the axis.                                                                             |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_Stop (Forced Stop) is aborted.                                                                              |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                            |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used |

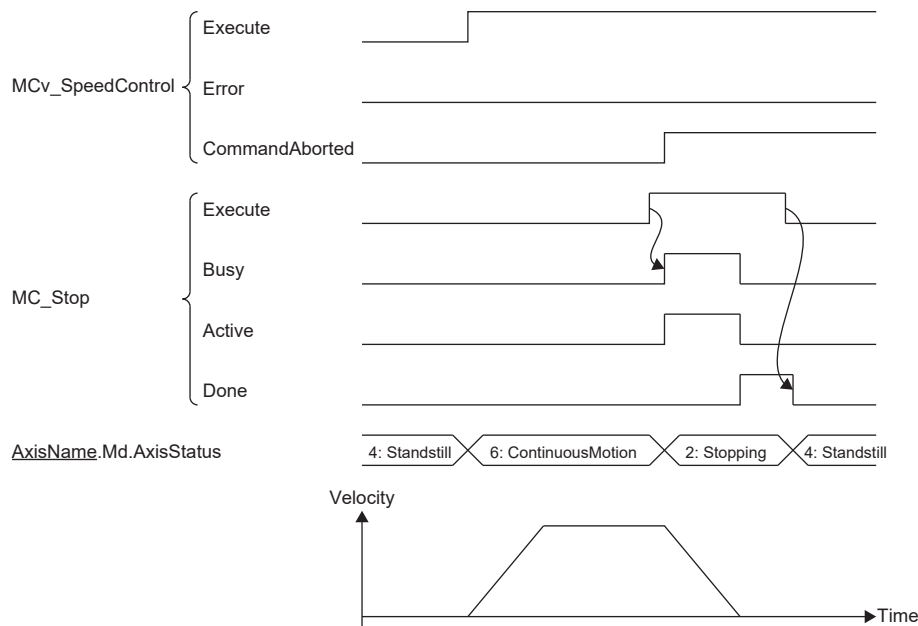
## Processing details

- This FB sets Deceleration (Deceleration) and decelerates the under-control FB to a stop.
- When MC\_Stop (Forced Stop) is executed, Abortion of execution (CommandAborted) becomes TRUE for the FB being executed and Axis status (AxisName.Md.AxisStatus) transits to "2: Decelerating to Stop (Stopping)". While Execution command (Execute) is TRUE or if the velocity has not reached "0.0", "2: Decelerating to Stop (Stopping)" is maintained. When Execution completion (Done) becomes TRUE and Execution command (Execute) becomes FALSE at stop completion, the axis status changes to "4: Standby (Standstill)".

## Timing chart

- When the processing is completed successfully

When MC\_Stop (Forced Stop) is executed during MCv\_SpeedControl (Speed Control (Including Position Loop))



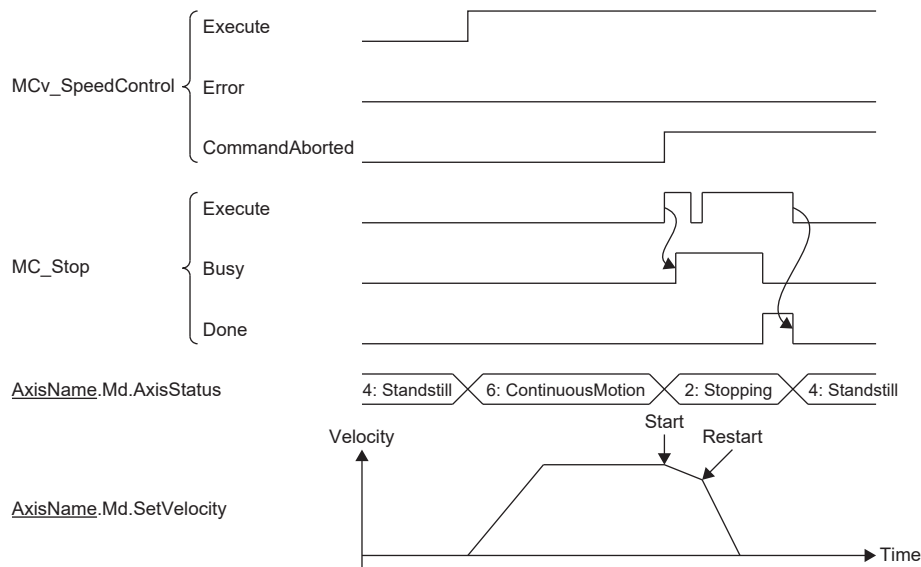
- When the processing is completed with an error

For the timing chart, refer to the following.

Page 1432 Basic operation of Execution command (Execute) type motion control FBs

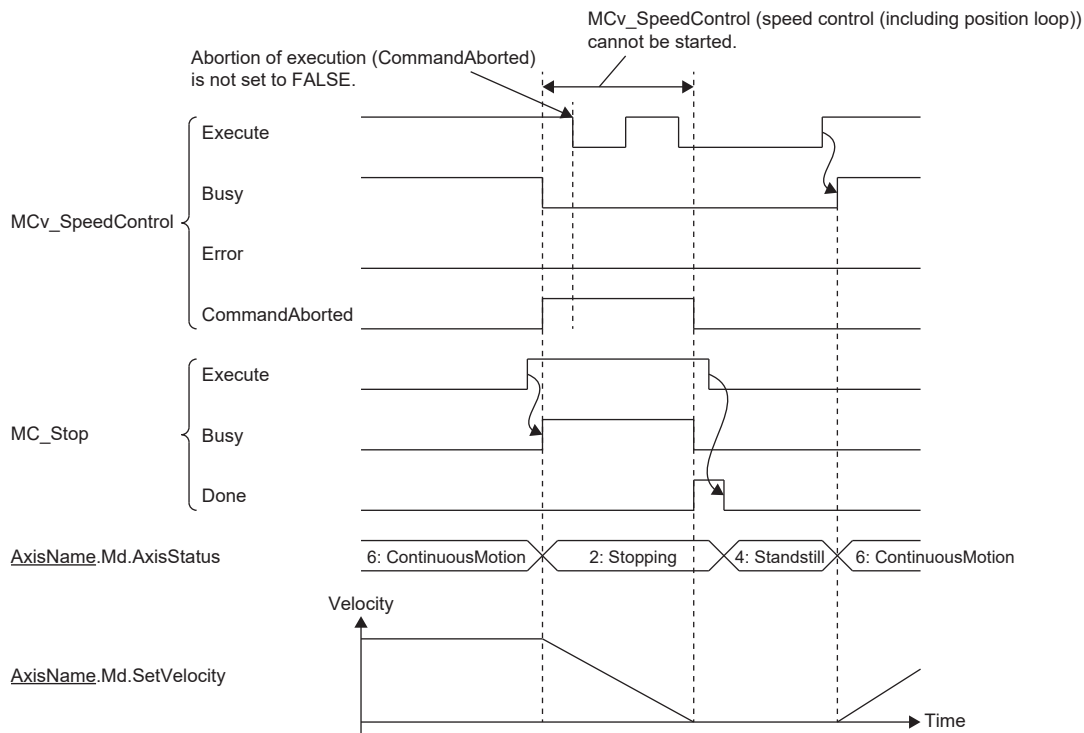
## ■ Operation overview

- When input variable Execution command (Execute) is TRUE during deceleration stop with MC\_Stop (Forced Stop), operation commands other than MC\_Stop (Forced Stop) are not accepted.
- If Deceleration (Deceleration) is set to "0.0" or omitted, immediate stop will be executed.
- The acceleration/deceleration method and the jerk take over the method specified in the on-going control and decelerate.
- If MC\_GroupStop (Group Forced Stop) is executed during single axis synchronous control, synchronization to the master axis will be canceled.
- When the setting value of Deceleration (Deceleration) is changed and MC\_Stop (Forced Stop) is restarted, the deceleration stop is executed from the restart point based on the value of Deceleration (Deceleration) in MC\_Stop (Forced Stop).



- When an FB that operates axes other than MC\_Stop (Forced Stop) is executed while Axis status (AxisName.Md.AxisStatus) is set to "2: Decelerating to Stop (Stopping)", Start Not Possible (error code: 1AFCH) occurs and Error (Error) becomes TRUE for MC\_Stop (Forced Stop) and Axis status (AxisName.Md.AxisStatus) changes to "1: Stopping on Error (ErrorStop)".
- After the axis stops, the axis status can be transitioned to "4: Standby (Standstill)" by executing Axis Error Reset (AxisName.Cd.ErrorReset).

- Even if MC\_Stop (Forced Stop) is used to set Execution command (Execute) to FALSE for the FB whose execution was aborted, once the stop operation starts, Abortion of execution (CommandAborted) remains TRUE until the stop is completed. After the stop completes, Abortion of execution (CommandAborted) becomes FALSE if Execution command (Execute) is FALSE for the FB whose execution was aborted.



## Program example

The following is a program example. The axis stop request (bStop) is set to TRUE, and Axis 1 (Axis0001) is decelerated to a stop at a deceleration of "100000.0".

### Axis

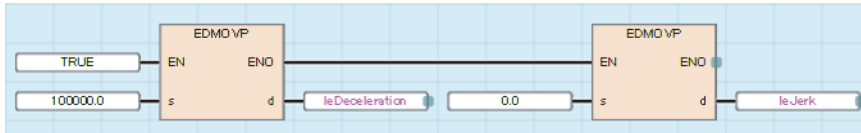
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### Labels used

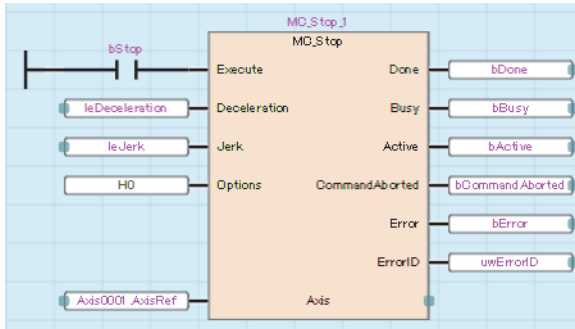
| Label name      | Data type                           | Comment               |
|-----------------|-------------------------------------|-----------------------|
| MC_Stop_1       | MC_Stop                             | Forced Stop FB        |
| bStop           | Bit                                 | Axis stop request     |
| leDeceleration  | Double-precision real number        | Deceleration          |
| leJerk          | Double-precision real number        | Jerk                  |
| bDone           | Bit                                 | Completion            |
| bBusy           | Bit                                 | Executing             |
| bActive         | Bit                                 | Controlling           |
| bCommandAborted | Bit                                 | Abortion of execution |
| bError          | Bit                                 | Error                 |
| uwErrorID       | Word [unsigned]/bit string [16-bit] | Error code            |

## ■FBD/LD program

- Data setting for axis stop



- Axis stop



## ■ST program

//-----Data setting for axis stop-----

leDeceleration:= 100000.0;

leJerk:= 0.0;

//-----Axis stop-----

MC\_Stop\_1(

Axis:= Axis0001.AxisRef ,

Execute:= bStop ,

Deceleration:= leDeceleration ,

Jerk:= leJerk ,

Options:= H00000000 ,

Done=> bDone ,

Busy=> bBusy ,

Active=> bActive ,

CommandAborted=> bCommandAborted ,

Error=> bError ,

ErrorID=> uwErrorID

);



## 46.3 Group Forced Stop

46

### MC\_GroupStop

Decelerates the specified axes group to a stop.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                  |
|--------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MC_GroupStop(   AxesGroup:= ?AXES_GROUP_REF? ,   Execute:= ?BOOL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### ■ I/O variables

| I/O variable | Name                   | Data type      | Input    | Valid range | Default value         | Description                                                                                                                                                                                |
|--------------|------------------------|----------------|----------|-------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxesGroup    | Axes group information | AXES_GROUP_REF | At start | —           | Omission not possible | An axes group is set.<br>For the variable ( <u>AxesGroupName.AxesGroupRef.</u> ) used, refer to the following.<br>Page 1468<br><u>AxesGroupName.AxesGroupRef.</u> (Axes group information) |

#### ■ Input variable

| Input variable | Name              | Data type  | Input                       | Valid range                    | Default value | Description                                                                                                                                                                                                                                                                                                                                     |
|----------------|-------------------|------------|-----------------------------|--------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute        | Execution command | BOOL       | At start                    | TRUE, FALSE                    | FALSE         | When this variable is set to TRUE, MC_GroupStop (Group Forced Stop) is executed.                                                                                                                                                                                                                                                                |
| Deceleration   | Deceleration      | LREAL      | At start/Retrigger possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The deceleration is set.<br>The setting value differs depending on the acceleration/deceleration method.<br>For details, refer to "Acceleration/deceleration processing function" in the following.<br>User's manual for the controller used<br>* The acceleration/deceleration method takes over the method specified in the on-going control. |
| Jerk           | Jerk              | LREAL      | At start                    | 0.0                            | 0.0           | Set "0.0".<br>* If a value other than "0.0" is set, Out of Jerk Range (error code: 1A8FH) occurs.                                                                                                                                                                                                                                               |
| Options        | Options           | DWORD(HEX) | At start                    | 00000000H                      | 00000000H     | Set "00000000H".<br>* If a value other than "00000000H" is set, Out of Options Range (error code: 1ABBH) occurs.                                                                                                                                                                                                                                |

## ■Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                 |
|-----------------|-----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when the velocity reaches 0.                                                                                                     |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when operating the velocity toward 0.                                                                                            |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MC_GroupStop (Group Forced Stop) is controlling the axes.                                                                  |
| Command Aborted | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_GroupStop (Group Forced Stop) is aborted.                                                                   |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                            |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used |

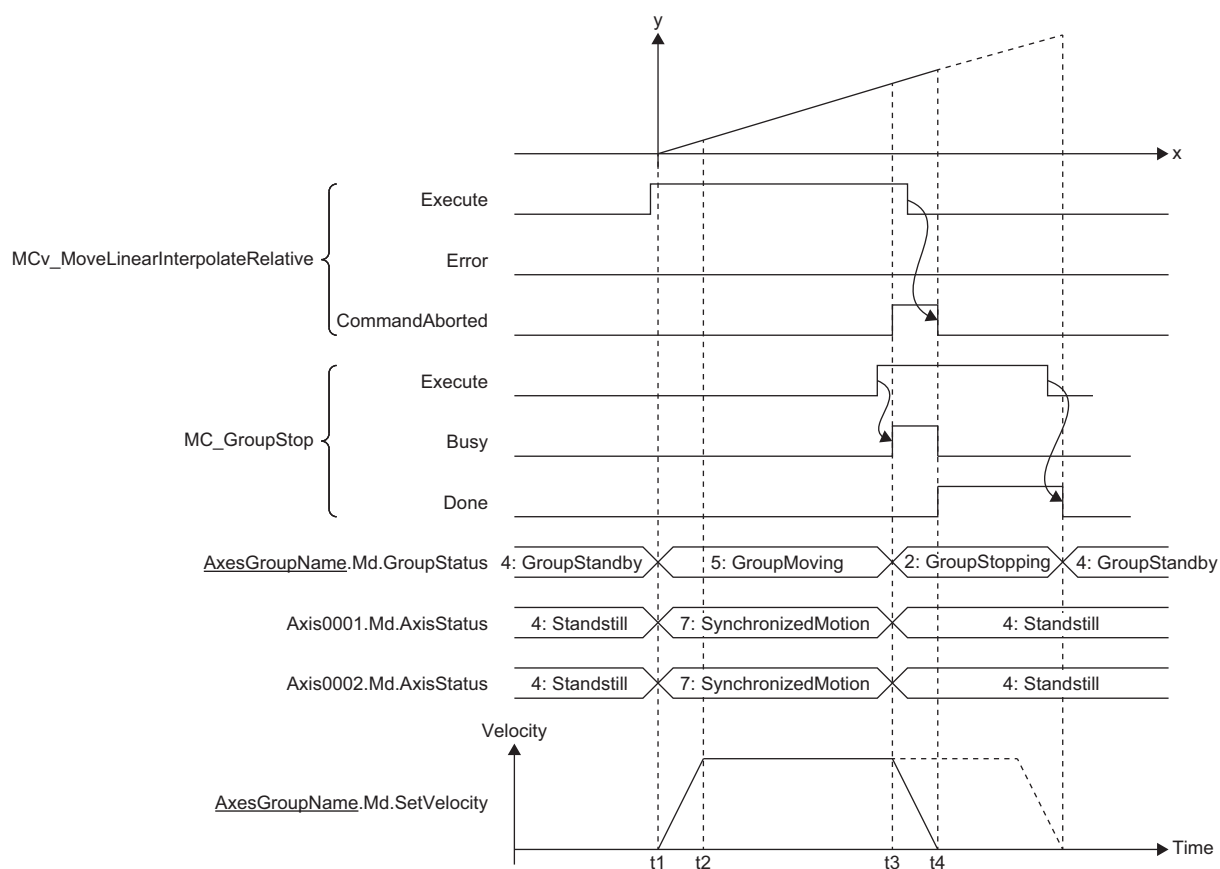
## Processing details

- This FB sets Deceleration (Deceleration) and decelerates the under-control FB to a stop. The axes group passes through the previous operation path and decelerates to a stop.
- When MC\_GroupStop (Group Forced Stop) is executed, Abortion of execution (CommandAborted) of the FB being executed becomes TRUE and Axes group status (AxesGroupName.Md.GroupStatus) transits to "2: Decelerating to Stop (GroupStopping)". While Execution command (Execute) is TRUE or if the velocity has not reached "0.0", "2: Decelerating to Stop (GroupStopping)" is maintained. When Execution completion (Done) becomes TRUE and Execution command (Execute) becomes FALSE at stop completion, the axis group status changes to "4: Standby (GroupStandby)".

## ■Timing chart

- When the processing is completed successfully

When MC\_GroupStop (Group Forced Stop) is executed during MCv\_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control)



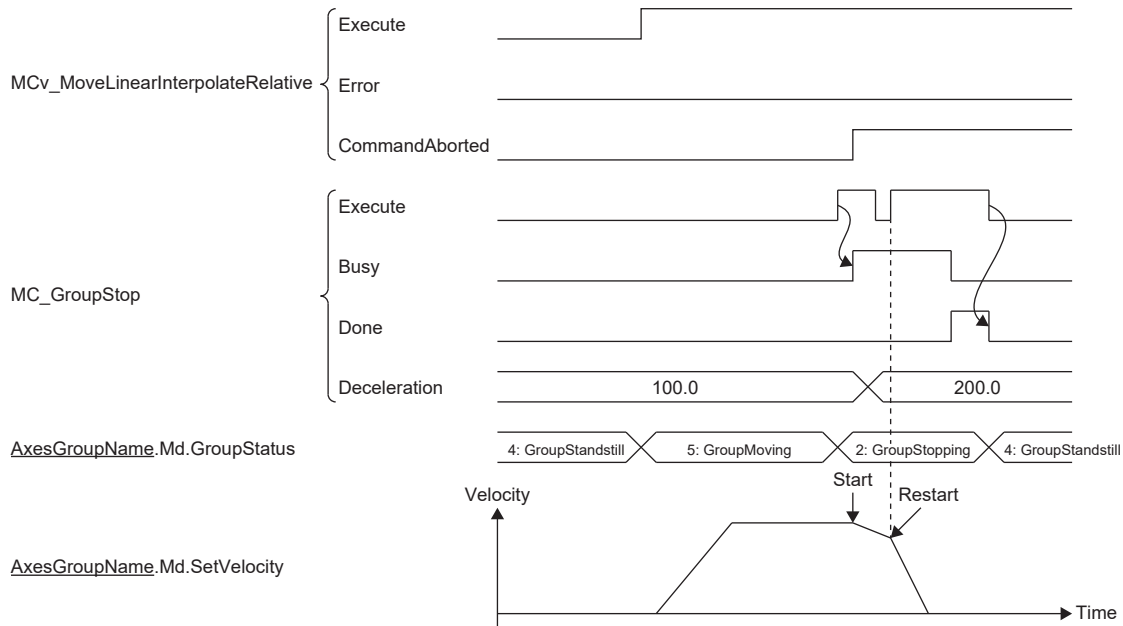
- When the processing is completed with an error

For the timing chart, refer to the following.

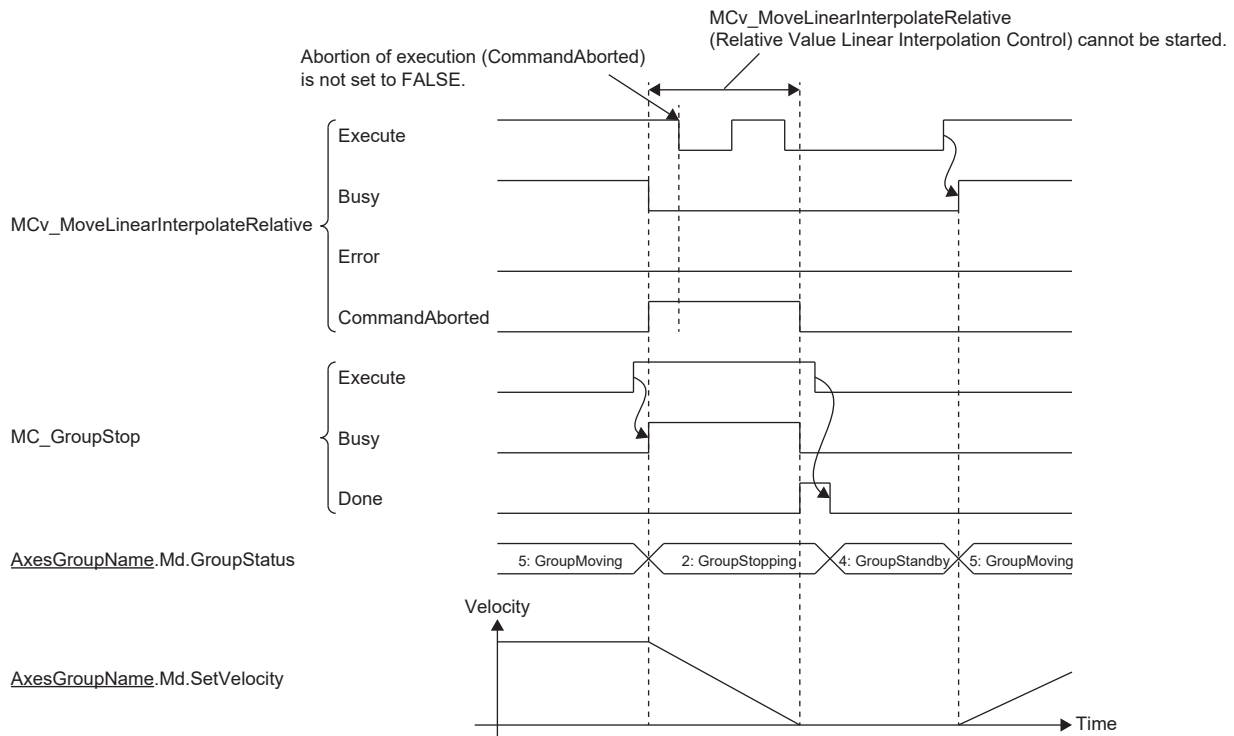
Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■ Operation overview

- When input variable Execution command (Execute) is TRUE during deceleration stop with MC\_GroupStop (Group Forced Stop), operation commands other than MC\_GroupStop (Group Forced Stop) are not accepted.
- If Deceleration (Deceleration) is set to "0.0" or omitted, immediate stop will be executed.
- The acceleration/deceleration method and the jerk take over the method specified in the on-going control and decelerate.
- When the setting value of Deceleration (Deceleration) is changed and MC\_GroupStop (Group Forced Stop) is restarted, the deceleration stop is executed from the restart point based on the value of Deceleration (Deceleration) in MC\_GroupStop (Group Forced Stop) and Jerk (Jerk) of the under-control FB.



- When an FB that operates axes other than MC\_GroupStop (Group Forced Stop) is executed while Axes group status (AxesGroupName.Md.GroupStatus) is set to "2: Decelerating to Stop (GroupStopping)", Start Not Possible (error code: 1AFCH) occurs and Error (Error) becomes TRUE for MC\_GroupStop (Group Forced Stop) and Axes group status (AxesGroupName.Md.GroupStatus) changes to "1: Stopping on Error (GroupErrorStop)".
- Even if MC\_GroupStop (Group Forced Stop) is used to set Execution command (Execute) to FALSE for the FB whose execution was aborted, once the stop operation starts, Abortion of execution (CommandAborted) remains TRUE until the stop is completed. After the stop completes, Abortion of execution (CommandAborted) becomes FALSE if Execution command (Execute) is FALSE for the FB whose execution was aborted.



## Program example

The following is a program example. The axes group stop request (bGroupStop) is set to TRUE, and Axes group 1 (AxesGroup001) is decelerated to a stop at a deceleration of "100000.0".

### ■Axes group

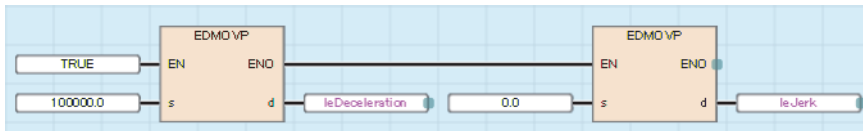
| Axes group No. | Label name   | Data type      | Comment      |
|----------------|--------------|----------------|--------------|
| 1              | AxesGroup001 | AXES_GROUP_REF | Axes group 1 |

### ■Labels used

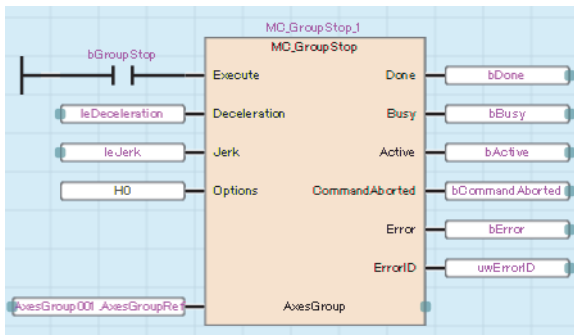
| Label name      | Data type                           | Comment                 |
|-----------------|-------------------------------------|-------------------------|
| MC_GroupStop_1  | MC_GroupStop                        | Axes group stop FB      |
| bGroupStop      | Bit                                 | Axes group stop request |
| leDeceleration  | Double-precision real number        | Deceleration            |
| leJerk          | Double-precision real number        | Jerk                    |
| bDone           | Bit                                 | Completion              |
| bBusy           | Bit                                 | Executing               |
| bActive         | Bit                                 | Controlling             |
| bCommandAborted | Bit                                 | Abortion of execution   |
| bError          | Bit                                 | Error                   |
| uwErrorID       | Word [unsigned]/bit string [16-bit] | Error code              |

### ■FBD/LD program

- Data setting for axes group stop



- Axes group stop



## ■ST program

//-----Data setting for axes group stop-----

leDeceleration:= 100000.0;

leJerk:= 0.0;

//-----Axes group stop-----

MC\_GroupStop\_1(

  AxesGroup:= AxesGroup001.AxesGroupRef ,

  Execute:= bGroupStop ,

  Deceleration:= leDeceleration ,

  Jerk:= leJerk ,

  Options:= H00000000 ,

  Done=> bDone ,

  Busy=> bBusy ,

  Active=> bActive ,

  CommandAborted=> bCommandAborted ,

  Error=> bError ,

  ErrorID=> uwErrorID

);

# 46.4 Absolute Value Positioning

46

## MC\_MoveAbsolute

This FB sets the target position of the absolute position and performs positioning.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MC_MoveAbsolute(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   Position:= ?LREAL? ,   Velocity:= ?LREAL? ,   Acceleration:= ?LREAL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   Direction:= ?INT? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable    | Name              | Data type | Input                                                    | Valid range                     | Default value | Description                                                                                                                                                                                                     |
|-------------------|-------------------|-----------|----------------------------------------------------------|---------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute           | Execution command | BOOL      | At start                                                 | TRUE, FALSE                     | FALSE         | When this variable is set to TRUE, MC_MoveAbsolute (Absolute Value Positioning) is executed.                                                                                                                    |
| Continuous Update | Continuous update | BOOL      | At start                                                 | TRUE, FALSE                     | FALSE         | Whether to enable or disable continuous change of Target position (Position), Velocity (Velocity), Acceleration (Acceleration), and Deceleration (Deceleration) is set.<br>• FALSE: Disabled<br>• TRUE: Enabled |
| Position          | Target position   | LREAL     | At start/ Retrigger possible/ Continuous update possible | -10000000000.0 to 10000000000.0 | 0.0           | The target position of the absolute position is set.<br>The settable range varies for each setting.<br>For details, refer to the following.<br>Page 1672 Target position (Position)                             |
| Velocity          | Velocity          | LREAL     | At start/ Retrigger possible/ Continuous update possible | 0.0, 0.0001 to 2500000000.0     | 0.0           | The velocity is set.<br>For details, refer to the following.<br>Page 1673 Velocity (Velocity)                                                                                                                   |

| Input variable | Name                | Data type            | Input                                                          | Valid range                    | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|---------------------|----------------------|----------------------------------------------------------------|--------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Acceleration   | Acceleration        | LREAL                | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The acceleration is set.<br>For details, refer to the following.<br> Page 1673 Acceleration (Acceleration)                                                                                                                                                                                                                                                                                                                                                                                                         |
| Deceleration   | Deceleration        | LREAL                | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The deceleration is set.<br>For details, refer to the following.<br> Page 1673 Deceleration (Deceleration)                                                                                                                                                                                                                                                                                                                                                                                                         |
| Jerk           | Jerk                | LREAL                | At start                                                       | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The jerk is set.<br>For details, refer to the following.<br> Page 1673 Jerk (Jerk)                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Direction      | Direction selection | INT (MC_DIRECTION)   | At start                                                       | 1 to 3                         | 0             | When software stroke limit is disabled, the direction used to move from the current position to the target position is set.<br><ul style="list-style-type: none"> <li>• 1: Positive direction (mcPositiveDirection)</li> <li>• 2: Negative direction (mcNegativeDirection)</li> <li>• 3: Shortest path (mcShortestWay)</li> </ul> * If this setting is omitted, Out of Direction Selection Range (error code: 1AA5H) occurs.<br>For details, refer to the following.<br> Page 1674 Direction selection (Direction) |
| BufferMode     | Buffer mode         | INT (MC_BUFFER_MODE) | At start                                                       | 0 to 5                         | 0             | The buffer mode is set.<br><ul style="list-style-type: none"> <li>• 0: Aborting (mcAborting)</li> <li>• 1: Buffered (mcBuffered)</li> <li>• 2: BlendingLow (mcBlendingLow)</li> <li>• 3: BlendingPrevious (mcBlendingPrevious)</li> <li>• 4: BlendingNext (mcBlendingNext)</li> <li>• 5: BlendingHigh (mcBlendingHigh)</li> </ul> For details, refer to the following.<br> Page 1677 Buffer mode (BufferMode)                                                                                                    |
| Options        | Options             | DWORD(HEX)           | At start                                                       | 00000000H to 00010021H         | 00000000H     | The function options for MC_MoveAbsolute (Absolute Value Positioning) are set in the specified bit position.<br>For details, refer to the following.<br> Page 1678 Options (Options)                                                                                                                                                                                                                                                                                                                             |

## ■ Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                     |
|-----------------|-----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when the target position is reached.                                                                                                                                                                                 |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MC_MoveAbsolute (Absolute Value Positioning) is being executed.<br>This variable becomes FALSE after the target position is reached.                                                                            |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MC_MoveAbsolute (Absolute Value Positioning) is controlling the axis.<br>This variable becomes FALSE after the target position is reached.                                                                     |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_MoveAbsolute (Absolute Value Positioning) is aborted.<br>The variable becomes FALSE when Execution command (Execute) becomes FALSE.                                                             |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |



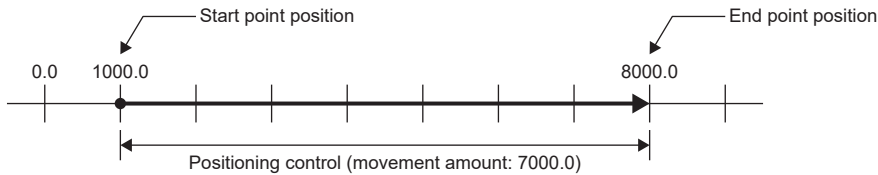
## Processing details

- This FB sets Target position (Position), Velocity (Velocity), Acceleration (Acceleration), Deceleration (Deceleration), Jerk (Jerk), Direction selection (Direction), Buffer mode (BufferMode), and Options (Options), and executes positioning from the current position at start (start point position) to the specified position (end point position) set in Target position (Position).

### Ex.

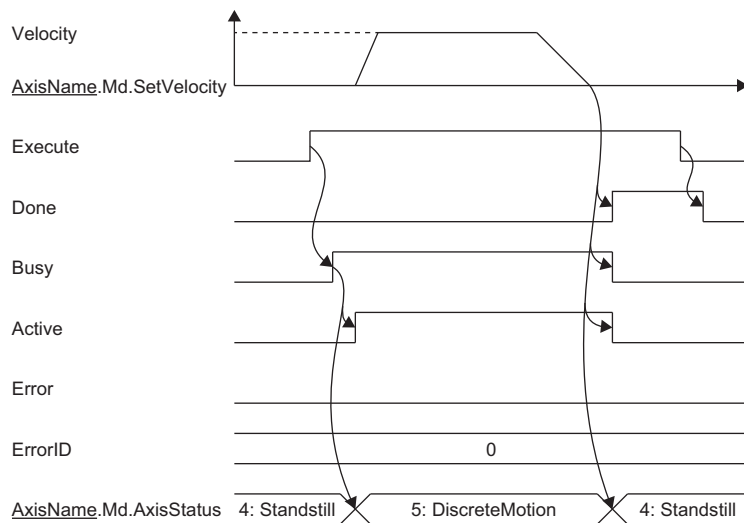
When the start point position (current stop position) is "1000.0" and Target position (Position) is set to "8000.0"

- Positioning is performed in the positive direction for a movement amount of "7000.0 (8000.0 - 1000.0)"



### ■ Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

📖 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■Target position (Position)

Sets the target position of the absolute position. The valid range differs depending on whether the software stroke limit is valid/invalid, Direction selection (Direction), and the setting for Target position specification exceeding the ring counter (Options (Options): Bit 16).

- When the software stroke limit is valid (when Software stroke limit target (AxisName.Md.SwStrokeLimit\_Target) is set to a value other than "-1: Invalid (Invalid)")

The valid range is as follows regardless of Direction selection (Direction) and the setting for Target position specification exceeding the ring counter (Options (Options): Bit 16).

| Valid range                                                                       |
|-----------------------------------------------------------------------------------|
| Ring counter lower limit value ≤ Target position < Ring counter upper limit value |

If a value outside the range is set, Out of Target Position Range (error code: 1A85H) occurs and the axis will not start. In addition, even when the value set is within the valid range, Software Stroke Limit Over (Target Position) (error code: 1A80H) occurs and the axis will not start if a position which exceeds the software stroke limit is specified as the target position.

- When the software stroke limit is invalid (when Software stroke limit target (AxisName.Md.SwStrokeLimit\_Target) is set to "-1: Invalid (Invalid)")

Setting "Target position specification exceeding the ring counter (Options (Options): Bit 16)" to "1: Allow" allows execution of positioning that exceeds the ring counter range by one revolution or more.

If a value outside the range is set, Out of Target Position Range (error code: 1A85H) occurs and the axis will not start.

| Direction selection (Direction)             | Target position specification exceeding the ring counter (Options (Options): Bit 16) | Valid range                                                                            |
|---------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 1: Positive direction (mcPositiveDirection) | 0: Disabled                                                                          | Ring counter lower limit value ≤ Target position < Ring counter upper limit value      |
|                                             | 1: Enabled                                                                           | Ring counter lower limit value ≤ Target position < Positioning range upper limit value |
| 2: Negative direction (mcNegativeDirection) | 0: Disabled                                                                          | Ring counter lower limit value ≤ Target position < Ring counter upper limit value      |
|                                             | 1: Enabled                                                                           | Positioning range lower limit value ≤ Target position < Ring counter upper limit value |
| 3: Shortest path (mcShortestWay)            | 0: Disabled                                                                          | Ring counter lower limit value ≤ Target position < Ring counter upper limit value      |
|                                             | 1: Enabled                                                                           | Ring counter lower limit value ≤ Target position < Ring counter upper limit value      |

- For the direction used to move to the target position, refer to the following.

📖 Page 1674 Direction selection (Direction)

## ■Velocity (Velocity)

Sets the command velocity used in MC\_MoveAbsolute (Absolute Value Positioning).

| Setting range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.0, 0.0001 to 2500000000.0 <sup>*1</sup> <sup>*2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p>*1 To perform floating-point operation, the lower limit value of the command velocity is limited by the following restrictions.<br/>If the velocity converted from the command velocity to operation cycle is less than 0.00001, Out of Operation Cycle Converted Velocity Range (error code: 1B16H) (when changing the velocity, Out of Operation Cycle Converted Velocity Range Warning (event code: 00D2FH)) occurs. To improve the precision of floating-point operation, change Position command unit (<u>AxisName</u>.Pr.Unit_Position) and Speed command unit (<u>AxisName</u>.Pr.Unit_Velocity) and perform settings so that the velocity converted into the operation cycle is not less than "0.00001".</p> <p>*2 When a Motion control FB with a commanded velocity of "0.0" performs a multiple start, the commanded velocity of the previous Motion control FB is used.</p> |

## ■Acceleration (Acceleration)

Sets the acceleration used in MC\_MoveAbsolute (Absolute Value Positioning).

The setting range differs depending on the setting for Acceleration/deceleration method setting (Options (Options): Bit 0 to 2).

| Acceleration/deceleration method setting<br>(Options (Options): Bit 0 to 2) | Setting range                                                                           |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method<br>(mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0 [U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method<br>(mcFixedTime)             | 0.000000 <sup>*1</sup> , positive numbers from 0.000001 to 8400.0[s]                    |

- \*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Deceleration (Deceleration)

Sets the deceleration used in MC\_MoveAbsolute (Absolute Value Positioning).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Deceleration (Deceleration) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting<br>(Options (Options): Bit 0 to 2) | Setting range                                                                           |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method<br>(mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0 [U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method<br>(mcFixedTime)             | Not used                                                                                |

- \*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Jerk (Jerk)

Sets the jerk used in MC\_MoveAbsolute (Absolute Value Positioning).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Jerk (Jerk) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting<br>(Options (Options): Bit 0 to 2) | Setting range                                                            |
|-----------------------------------------------------------------------------|--------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method<br>(mcAccDec)             | 0.0000, positive numbers from 0.0001 to 2147483647.0 [U/s <sup>3</sup> ] |
| 1: Acceleration/deceleration time-fixed method<br>(mcFixedTime)             | Not used                                                                 |

## ■Direction selection (Direction)

The setting for Direction selection (Direction) is ignored when the software stroke limit is valid. Positioning control is performed in a direction which does not cross over into the area outside the software stroke limit range. If the value does not cross over into the area outside the software stroke limit range in either the positive direction or the negative direction, positioning control is performed in the direction closest to the target position (the direction in which the absolute value of the movement amount is shortest) based on the current position. If the distance is the same in both the positive direction and the negative direction, control is performed using the current direction.

When the software stroke limit is invalid, the direction used to move from the current position to the target position can be set by selecting from "1: Positive direction (mcPositiveDirection)", "2: Negative direction (mcNegativeDirection)", or "3: Shortest path (mcShortestWay)" in Direction selection (Direction).

- 1: Positive direction (mcPositiveDirection)

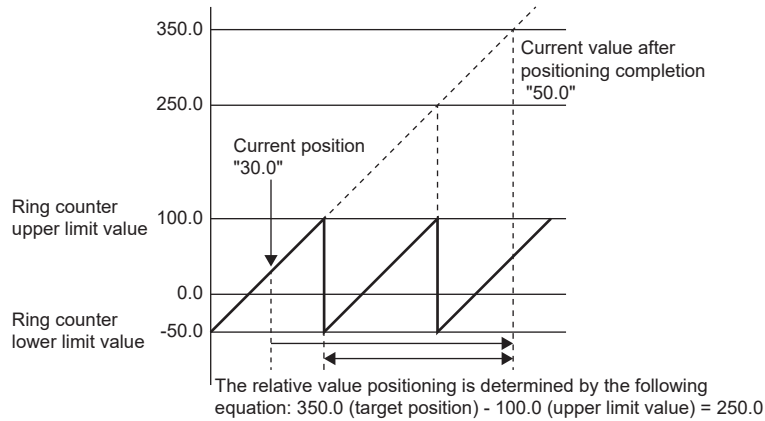
Performs positioning from the current position to the target position in the positive direction (address increasing).

| Target position specification exceeding the ring counter (Options): Bit 16                                                                                                                                                                                                                                                                                                                                                                                                        | Setting range                                                                                                                        | Operation |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>■0: Disabled</b><br>The setting range of the target position is "Ring counter lower limit value ≤ Target position < Ring counter upper limit value".                                                                                                                                                                                                                                                                                                                           | Current value ≤ Target position < Ring counter upper limit value                                                                     |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Ring counter lower limit value ≤ Target position < Current value                                                                     |           |
| <b>■1: Enabled</b><br>Allows positioning operation that overflows the ring counter upper limit value to be performed. For this setting, the ring counter upper limit value is used as a reference to perform positioning using the amount of movement exceeded as the relative movement amount. If the target position is set to a value smaller than the ring counter lower limit value, positioning does not start and Out of Target Position Range (error code: 1A85H) occurs. | Current value ≤ Target position < Ring counter upper limit value<br>Ring counter lower limit value ≤ Target position < Current value |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Ring counter upper limit value ≤ Target position < Positioning range upper limit value                                               |           |

**Ex.**

Operation when set to the values shown below (performs relative value positioning after exceeding the ring counter upper limit value).

- Ring counter upper limit value: 100.0
- Ring counter lower limit value: -50.0
- Current position: 30.0
- Target position: 350.0



- 2: Negative direction (mcNegativeDirection)

Performs positioning in the negative direction (address decreasing) from the current position to the target position.

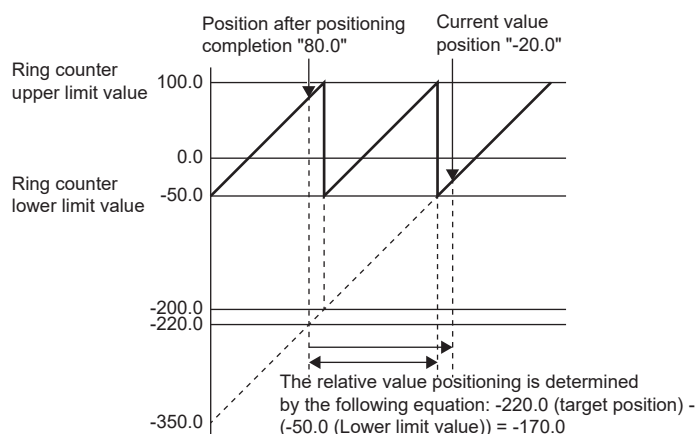
| Target position specification exceeding the ring counter (Options (Options): Bit 16)                                                                   | Setting range                                                    | Operation |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-----------|
| <b>0: Disabled</b><br>The setting range of the target position is "Ring counter lower limit value ≤ Target position < Ring counter upper limit value". | Ring counter lower limit value ≤ Target position ≤ Current value |           |
|                                                                                                                                                        | Current value < Target position < Ring counter upper limit value |           |

| Target position specification exceeding the ring counter (Options (Options): Bit 16)                                                                                                                                                                                                                                                                                                                                                                                                                     | Setting range                                                                                                                                                                                                                                                | Operation |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <p>■1: Enabled</p> <p>Allows positioning operation that underflows the ring counter lower limit value to be performed. For this setting, the ring counter lower limit value is used as a reference to perform positioning using the amount of movement exceeded as the relative movement amount.</p> <p>If the target position is set to a value equal to or larger than the ring counter upper limit value, positioning does not start and Out of Target Position Range (error code: 1A85H) occurs.</p> | <ul style="list-style-type: none"> <li>Ring counter lower limit value <math>\leq</math> Target position <math>\leq</math> Current value</li> <li>Current value <math>&lt;</math> Target position <math>&lt;</math> Ring counter upper limit value</li> </ul> |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Positioning range lower limit value $\leq$ Target position $<$ Ring counter lower limit value                                                                                                                                                                |           |

#### Ex.

Operation when set to the values shown below

- Operation when set to the values shown below
- Ring counter upper limit value: 100.0
- Ring counter lower limit value: -50.0
- Current position: -20.0
- Target position: -220.0



- 3: Shortest path (mcShortestWay)

Based on the current position, positioning control is performed in the direction closest to the target position (the direction in which the absolute value of the movement amount is shortest). If the distance is the same in both the positive direction and the negative direction, control is performed using the current direction. Regardless of the setting for Target position specification exceeding the ring counter (Options (Options): Bit 16), the setting range for the target position is "Ring counter lower limit value ≤ Target position < Ring counter upper limit value". If a value outside the range is set, Out of Target Position Range (error code: 1A85H) occurs and the axis will not start.

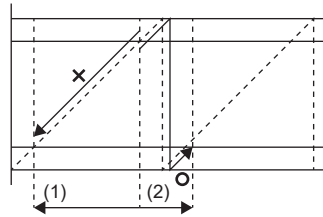
#### Ex.

Operation when set to the values shown below

- Ring counter upper limit value: 100.0
- Ring counter lower limit value: -100.0
- Current position: 80.0
- Target position: -80.0

Ring counter  
upper limit value: 100.0  
Current value: 80.0

Target position: -80.0  
Ring counter  
lower limit value: -100.0



\*1 Since the movement amount of (1) is "160.0" and the movement amount of (2) is "40.0", positioning moves in the positive direction from (2).

### ■ Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following buffer modes are settable in MC\_MoveAbsolute (Absolute Value Positioning).

| Setting value                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting)                 | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                                                                                                                                                                                                              |
| 1: Buffered (mcBuffered)                 | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB.                                                                                                                                                                                        |
| 2: BlendingLow (mcBlendingLow)           | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the lower target velocity between the under-control FB and the buffering FB is used as the switching speed.  |
| 3: BlendingPrevious (mcBlendingPrevious) | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the under-control FB is used as the switching speed.                                  |
| 4: BlendingNext (mcBlendingNext)         | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the buffering FB is used as the switching speed.                                      |
| 5: BlendingHigh (mcBlendingHigh)         | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the higher target velocity between the under-control FB and the buffering FB is used as the switching speed. |

\*1 Stops are not performed between the under-control FB and the buffering FB.

#### Point

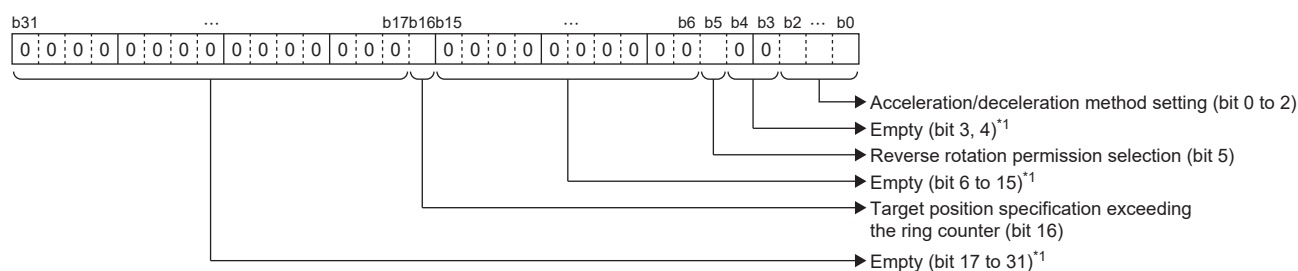
For details on multiple start (buffer mode), refer to the following.

📖 User's manual for the controller used

## Options (Options)

The function options for MC\_MoveAbsolute (Absolute Value Positioning) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit    | Name                                                     | Description                                                                                                                                                                                                                                                                                                                                       |
|--------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 2 | Acceleration/deceleration method setting                 | Sets the acceleration/deceleration method used to perform control. <ul style="list-style-type: none"> <li>0: Acceleration/deceleration specification method (mcAccDec)</li> <li>1: Acceleration/deceleration time-fixed method (mcFixedTime)</li> </ul>                                                                                           |
| 5      | Reverse rotation permission selection                    | Sets whether to allow reverse rotation when the operation direction of the FB being executed and the buffering FB are different. <ul style="list-style-type: none"> <li>0: Enabled</li> <li>1: Disabled</li> </ul> *: This bit is valid when switching to the subsequent buffering FB during axis operation or when changing the target position. |
| 16     | Target position specification exceeding the ring counter | Sets whether to allow a target position that exceeds the ring counter upper limit value or lower limit value when the software stroke limit is invalid. <ul style="list-style-type: none"> <li>0: Disabled</li> <li>1: Enabled</li> </ul>                                                                                                         |

### • Acceleration/deceleration method setting (Bit 0 to 2)

| Setting value                                                | Description                                                                                                                                                                                                                                                                                      |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec) | An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) set in MC_MoveAbsolute (Absolute Value Positioning).                                                                                                                         |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime) | An acceleration/deceleration method using the acceleration/deceleration time specified in MC_MoveAbsolute (Absolute Value Positioning) regardless of the velocity.<br>The acceleration/deceleration time does not use Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). |

### • Reverse rotation permission selection (Bit 5)

| Setting value | Description                                                                                                                                            |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Enabled    | Allows reverse rotation.<br>Performs a deceleration stop once, then starts operation to the changed direction once the deceleration stop is completed. |
| 1: Disabled   | Does not allow reverse rotation.<br>When switched, Overrun Error (error code: 1AE3H) occurs and a deceleration stop is performed.                      |

## Necessary object data

When using MC\_MoveAbsolute (Absolute Value Positioning), set the following object data for the axis.

- Target position (607AH)

If the object data is not set, Necessary Slave Object Unset (error code: 1AF7H) occurs and the axis will not start.

For details on object data settings, refer to the following.

User's manual for the controller used



## Program example

The following is a program example. The single axis absolute value positioning start (bMoveAbsolute) is set to TRUE, and absolute positioning control is performed for Axis 1 (Axis0001).

- Operation



- Settings

| Item            | Setting value |
|-----------------|---------------|
| Target position | 80000.0       |
| Velocity        | 50000.0       |
| Acceleration    | 100000.0      |
| Deceleration    | 100000.0      |
| Jerk            | 0.0           |

### ■Axis

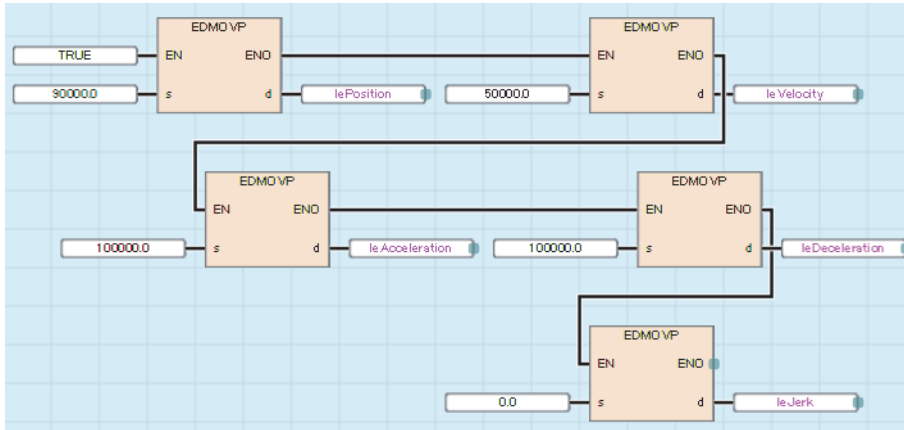
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### ■Labels used

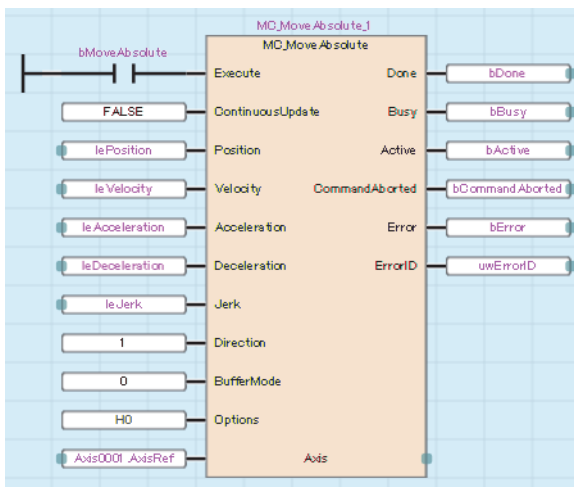
| Label name        | Data type                           | Comment                                      |
|-------------------|-------------------------------------|----------------------------------------------|
| MC_MoveAbsolute_1 | MC_MoveAbsolute                     | Absolute Value Positioning FB                |
| bMoveAbsolute     | Bit                                 | Single axis absolute value positioning start |
| lePosition        | Double-precision real number        | Target position                              |
| leVelocity        | Double-precision real number        | Velocity                                     |
| leAcceleration    | Double-precision real number        | Acceleration                                 |
| leDeceleration    | Double-precision real number        | Deceleration                                 |
| leJerk            | Double-precision real number        | Jerk                                         |
| bDone             | Bit                                 | Execution completion                         |
| bBusy             | Bit                                 | Executing                                    |
| bActive           | Bit                                 | Controlling                                  |
| bCommandAborted   | Bit                                 | Abortion of execution                        |
| bError            | Bit                                 | Error                                        |
| uwErrorID         | Word [unsigned]/bit string [16-bit] | Error code                                   |

## ■ FBD/LD program

- Data setting for single axis positioning control



- Absolute Value Positioning



## ■ST program

//-----Data setting for single axis positioning control-----

```
lePosition:= 80000.0;
leVelocity:= 50000.0;
leAcceleration:= 100000.0;
leDeceleration:= 100000.0;
leJerk:= 0.0;
```

//-----Absolute Value Positioning-----

```
MC_MoveAbsolute_1(
  Axis:= Axis0001.AxisRef ,
  Execute:= bMoveAbsolute ,
  ContinuousUpdate:= FALSE ,
  Position:= lePosition ,
  Velocity:= leVelocity ,
  Acceleration:= leAcceleration ,
  Deceleration:= leDeceleration ,
  Jerk:= leJerk ,
  Direction:= MC_DIRECTION__mcPositiveDirection ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= H00000000 ,
  Done=> bDone ,
  Busy=> bBusy ,
  Active=> bActive ,
  CommandAborted=> bCommandAborted ,
  Error=> bError ,
  ErrorID=> uwErrorID
);
```

# 46.5 Relative Value Positioning

## MC\_MoveRelative

This FB sets the movement amount of the relative position and performs positioning.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MC_MoveRelative(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   Distance:= ?LREAL? ,   Velocity:= ?LREAL? ,   Acceleration:= ?LREAL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                   |
|--------------|------------------|-----------|----------|-------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable (AxisName.AxisRef.) used, refer to the following.<br>Page 1444 AxisName.AxisRef. (Axis information) |

#### Input variable

| Input variable    | Name              | Data type | Input                                                    | Valid range                     | Default value | Description                                                                                                                                                                                                     |
|-------------------|-------------------|-----------|----------------------------------------------------------|---------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute           | Execution command | BOOL      | At start                                                 | TRUE, FALSE                     | FALSE         | When this variable is set to TRUE, MC_MoveRelative (Relative Value Positioning) is executed.                                                                                                                    |
| Continuous Update | Continuous update | BOOL      | At start                                                 | TRUE, FALSE                     | FALSE         | Whether to enable or disable continuous change of Movement amount (Distance), Velocity (Velocity), Acceleration (Acceleration), and Deceleration (Deceleration) is set.<br>• FALSE: Disabled<br>• TRUE: Enabled |
| Distance          | Movement amount   | LREAL     | At start/ Retrigger possible/ Continuous update possible | -10000000000.0 to 10000000000.0 | 0.0           | The relative position from the current position at start to the end point is set.<br>For details, refer to the following.<br>Page 1684 Movement amount (Distance)                                               |
| Velocity          | Velocity          | LREAL     | At start/ Retrigger possible/ Continuous update possible | 0.0, 0.0001 to 2500000000.0     | 0.0           | The velocity is set.<br>For details, refer to the following.<br>Page 1685 Velocity (Velocity)                                                                                                                   |

| Input variable | Name         | Data type               | Input                                                          | Valid range                    | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------|--------------|-------------------------|----------------------------------------------------------------|--------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Acceleration   | Acceleration | LREAL                   | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The acceleration is set.<br>For details, refer to the following.<br> Page 1685 Acceleration (Acceleration)                                                                                                                                                                                                                                                                                                    |
| Deceleration   | Deceleration | LREAL                   | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The deceleration is set.<br>For details, refer to the following.<br> Page 1685 Deceleration (Deceleration)                                                                                                                                                                                                                                                                                                    |
| Jerk           | Jerk         | LREAL                   | At start                                                       | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The jerk is set.<br>For details, refer to the following.<br> Page 1685 Jerk (Jerk)                                                                                                                                                                                                                                                                                                                            |
| BufferMode     | Buffer mode  | INT<br>(MC_BUFFER_MODE) | At start                                                       | 0 to 5                         | 0             | The buffer mode is set.<br><ul style="list-style-type: none"> <li>• 0: Aborting (mcAborting)</li> <li>• 1: Buffered (mcBuffered)</li> <li>• 2: BlendingLow (mcBlendingLow)</li> <li>• 3: BlendingPrevious (mcBlendingPrevious)</li> <li>• 4: BlendingNext (mcBlendingNext)</li> <li>• 5: BlendingHigh (mcBlendingHigh)</li> </ul> For details, refer to the following.<br> Page 1686 Buffer mode (BufferMode) |
| Options        | Options      | DWORD(HEX)              | At start                                                       | 00000000H to 00000021H         | 00000000H     | The function options for MC_MoveRelative (Relative Value Positioning) are set in the specified bit position.<br>For details, refer to the following.<br> Page 1687 Options (Options)                                                                                                                                                                                                                         |

## ■ Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                     |
|-----------------|-----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when the relative position is reached.                                                                                                                                                                               |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MC_MoveRelative (Relative Value Positioning) is executed.<br>This variable becomes FALSE after the relative position is reached.                                                                                |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MC_MoveRelative (Relative Value Positioning) is controlling the axis.<br>This variable becomes FALSE after the relative position is reached.                                                                   |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_MoveRelative (Relative Value Positioning) is aborted.<br>The variable becomes FALSE when Execution command (Execute) becomes FALSE.                                                             |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |

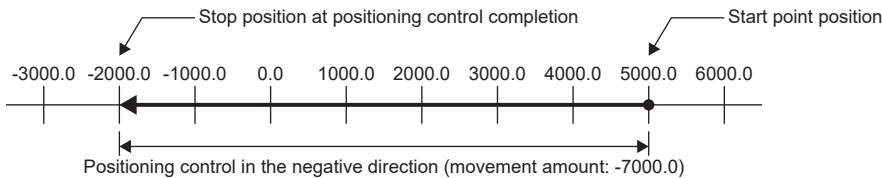
## Processing details

- This FB sets Movement amount (Distance), Velocity (Velocity), Acceleration (Acceleration), Deceleration (Deceleration), Jerk (Jerk), and Buffer mode (BufferMode), and executes positioning from the current position at start (start point position) using the movement amount set in Movement amount (Distance). The movement direction is determined by the sign of the movement amount. Axis status (AxisName.Md.AxisStatus) becomes "5: During positioning operation (DiscreteMotion)".

### Ex.

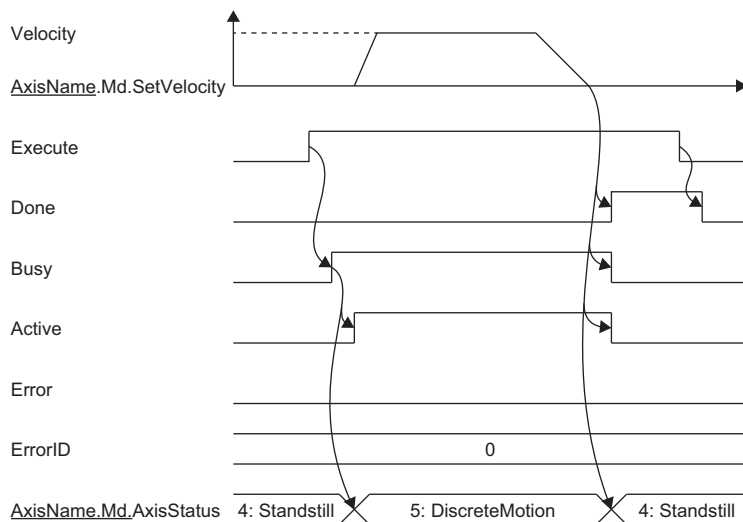
When the start point position (current stop position) is "5000.0" and the movement amount is set to "-7000.0"

- Positioning is performed to "-2000.0".



## Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## Movement amount (Distance)

This variable sets the movement amount from the current position at start to the end point.

The movement direction is determined by the sign (+/-) of the movement amount.

| Movement amount | Description                                                     |
|-----------------|-----------------------------------------------------------------|
| If positive (+) | Moves in the positive direction (address increasing direction). |
| If negative (-) | Moves in the negative direction (address decreasing direction). |

When the movement amount is "0", the axis is not operated but Execution completion (Done) becomes TRUE.

If the set movement amount is outside the range, Out of Target Position Range (error code: 1A85H) occurs and the operation will not start.

If "current value + movement amount" overflows the software stroke limit upper limit value or software stroke limit lower limit value when the software stroke limit is valid, Software Stroke Limit Over (target position) (error code: 1A80H) will occur and the operation will not start.

## ■Velocity (Velocity)

Sets the command velocity used in MC\_MoveRelative (Relative Value Positioning).

| Setting range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.0, 0.0001 to 2500000000.0 <sup>*1</sup> 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <p>*1 To perform floating-point operation, the lower limit value of the command velocity is limited by the following restrictions.<br/>If the velocity converted from the command velocity to operation cycle is less than 0.00001, Out of Operation Cycle Converted Velocity Range (error code: 1B16H) (when changing the velocity, Out of Operation Cycle Converted Velocity Range Warning (event code: 00D2FH)) occurs. To improve the precision of floating-point operation, change Position command unit (<a href="#">AxisName.Pr.Unit_Position</a>) and Speed command unit (<a href="#">AxisName.Pr.Unit_Velocity</a>) and perform settings so that the velocity converted into the operation cycle is not less than "0.00001".</p> <p>*2 When a Motion control FB with a commanded velocity of "0.0" performs a multiple start, the commanded velocity of the previous Motion control FB is used.</p> |

## ■Acceleration (Acceleration)

Sets the acceleration used in MC\_MoveRelative (Relative Value Positioning).

The setting range differs depending on the setting for Acceleration/deceleration method setting (Options (Options): Bit 0 to 2).

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | 0.000000 <sup>*1</sup> , positive numbers from 0.000001 to 8400.0[s]                   |

- \*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 ([AxisName.Pr.AccelerationZeroBehavior](#)). When changing the acceleration or deceleration, the changes are not accepted.

## ■Deceleration (Deceleration)

Sets the deceleration used in MC\_MoveRelative (Relative Value Positioning).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Deceleration (Deceleration) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                               |

- \*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 ([AxisName.Pr.AccelerationZeroBehavior](#)). When changing the acceleration or deceleration, the changes are not accepted.

## ■Jerk (Jerk)

Sets the jerk used in MC\_MoveRelative (Relative Value Positioning).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Jerk (Jerk) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                           |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000, positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                |

## ■ Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following buffer modes are settable in MC\_MoveRelative (Relative Value Positioning).

| Setting value                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting)                 | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                                                                                                                                                                                                              |
| 1: Buffered (mcBuffered)                 | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB.                                                                                                                                                                                        |
| 2: BlendingLow (mcBlendingLow)           | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the lower target velocity between the under-control FB and the buffering FB is used as the switching speed.  |
| 3: BlendingPrevious (mcBlendingPrevious) | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the under-control FB is used as the switching speed.                                  |
| 4: BlendingNext (mcBlendingNext)         | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the buffering FB is used as the switching speed.                                      |
| 5: BlendingHigh (mcBlendingHigh)         | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the higher target velocity between the under-control FB and the buffering FB is used as the switching speed. |

\*1 Stops are not performed between the under-control FB and the buffering FB.



For details on multiple start (buffer mode), refer to the following.

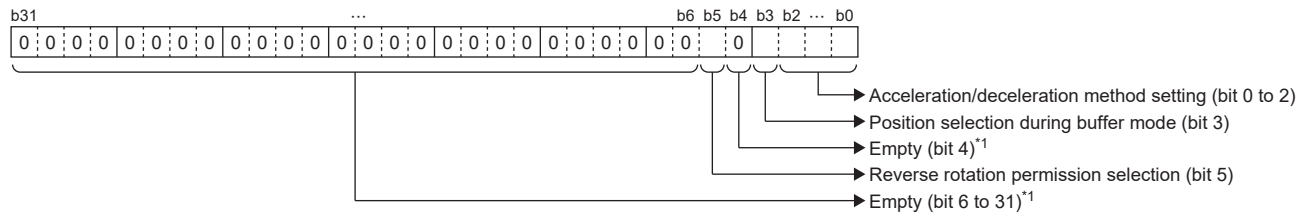
User's manual for the controller used



## Options (Options)

The function options for MC\_MoveRelative (Relative Value Positioning) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit    | Name                                     | Description                                                                                                                                                                                                                                                                                                                                              |
|--------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 2 | Acceleration/deceleration method setting | Sets the acceleration/deceleration method used to perform control. <ul style="list-style-type: none"> <li>0: Acceleration/deceleration specification method (mcAccDec)</li> <li>1: Acceleration/deceleration time-fixed method (mcFixedTime)</li> </ul>                                                                                                  |
| 3      | Position selection during buffer mode    | Sets the position when executing relative positioning control by multiple start. <ul style="list-style-type: none"> <li>0: Set position</li> <li>1: Actual position</li> </ul> <p>* This bit is valid when setting "0: Aborting (mcAborting)" in Buffer mode (BufferMode).</p>                                                                           |
| 5      | Reverse rotation permission selection    | Sets whether to allow reverse rotation when the operation direction of the FB being executed and the buffering FB are different. <ul style="list-style-type: none"> <li>0: Enabled</li> <li>1: Disabled</li> </ul> <p>*: This bit is valid when switching to the subsequent buffering FB during axis operation or when changing the target position.</p> |

### • Acceleration/deceleration method setting (Bit 0 to 2)

| Setting value                                                | Description                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec) | An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) set in MC_MoveRelative (Relative Value Positioning).                                                                                                                      |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime) | An acceleration/deceleration method using the acceleration/deceleration time specified in MC_MoveRelative (Relative Value Positioning) regardless of the velocity. The acceleration/deceleration time does not use Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). |

### • Position selection during buffer mode (Bit 3)

| Setting value      | Description                                                                                                                                                                                                                                                                                                                                                   |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Set position    | <p>Performs relative positioning control from the set position.</p> <p>&lt;Example&gt;</p> <p>When multiple start is performed with Movement amount (Distance) set to "5000.0" and Options (Options) set to "00000000H (Bit 3 is 0: Set position)"</p> <p>The position moves only the movement amount (Distance) according to the set position.</p>           |
| 1: Actual position | <p>Performs relative positioning control from the actual position.</p> <p>&lt;Example&gt;</p> <p>When multiple start is performed with Movement amount (Distance) set to "5000.0" and Options (Options) set to "00000008H (Bit 3 is 1: Actual position)".</p> <p>The position moves only the movement amount (Distance) according to the actual position.</p> |

- Reverse rotation permission selection (Bit 5)

| Setting value | Description                                                                                                                                            |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Enabled    | Allows reverse rotation.<br>Performs a deceleration stop once, then starts operation to the changed direction once the deceleration stop is completed. |
| 1: Disabled   | Does not allow reverse rotation.<br>When switched, Overrun Error (error code: 1AE3H) occurs and a deceleration stop is performed.                      |

## ■ Necessary object data

When using MC\_MoveRelative (Relative Value Positioning), set the following object data for the axis.

- Target position (607AH)

If the object data is not set, Necessary Slave Object Unset (error code: 1AF7H) occurs and the axis will not start.

For details on object data settings, refer to the following.

 User's manual for the controller used

## Precautions

- The current position where MC\_MoveRelative (Relative Value Positioning) was started for the first time is used as the start address even if a restart/continuous update is performed.
- Since floating point type processing is used, if relative positioning control is repeatedly executed, the set movement amount may not be reached due to a calculation error.

## Program example

The following is a program example. The single axis relative value positioning start (bMoveRelative) is set to TRUE, and relative positioning control is performed for Axis 1 (Axis0001).

### • Operation



### • Settings

| Item            | Setting value |
|-----------------|---------------|
| Target position | 80000.0       |
| Velocity        | 50000.0       |
| Acceleration    | 100000.0      |
| Deceleration    | 100000.0      |
| Jerk            | 0.0           |

### ■Axis

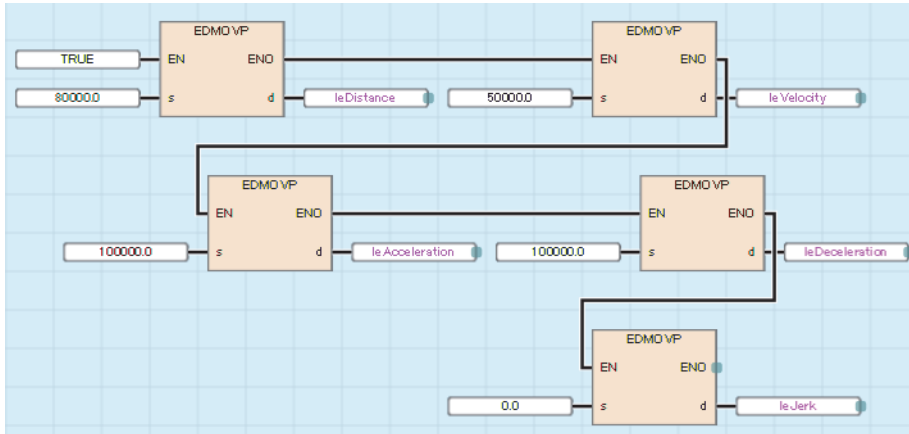
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### ■Labels used

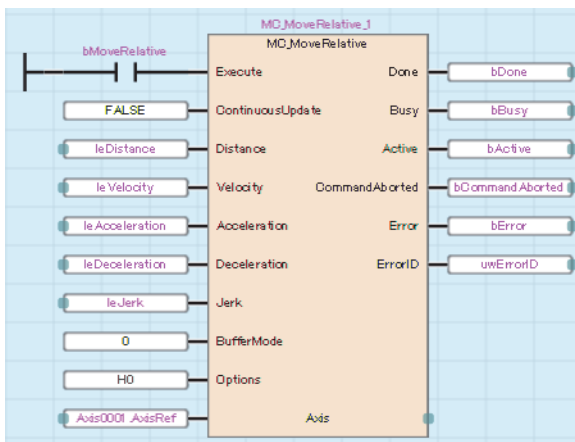
| Label name        | Data type                           | Comment                                      |
|-------------------|-------------------------------------|----------------------------------------------|
| MC_MoveRelative_1 | MC_MoveRelative                     | Relative Value Positioning FB                |
| bMoveRelative     | Bit                                 | Single axis relative value positioning start |
| leDistance        | Double-precision real number        | Movement amount                              |
| leVelocity        | Double-precision real number        | Velocity                                     |
| leAcceleration    | Double-precision real number        | Acceleration                                 |
| leDeceleration    | Double-precision real number        | Deceleration                                 |
| leJerk            | Double-precision real number        | Jerk                                         |
| bDone             | Bit                                 | Execution completion                         |
| bBusy             | Bit                                 | Executing                                    |
| bActive           | Bit                                 | Controlling                                  |
| bCommandAborted   | Bit                                 | Abortion of execution                        |
| bError            | Bit                                 | Error                                        |
| uwErrorID         | Word [unsigned]/bit string [16-bit] | Error code                                   |

## ■ FBD/LD program

- Data setting for single axis positioning control



- Relative Value Positioning



## ■ST program

//-----Data setting for single axis positioning control-----

leDistance:= 80000.0;

leVelocity:= 50000.0;

leAcceleration:= 100000.0;

leDeceleration:= 100000.0;

leJerk:= 0.0;

//-----Relative Value Positioning-----

MC\_MoveRelative\_1(

Axis:= Axis0001.AxisRef ,

Execute:= bMoveRelative ,

ContinuousUpdate:= FALSE ,

Distance:= leDistance ,

Velocity:= leVelocity ,

Acceleration:= leAcceleration ,

Deceleration:= leDeceleration ,

Jerk:= leJerk ,

BufferMode:= MC\_BUFFER\_MODE\_\_mcAborting ,

Options:= H00000000 ,

Done=> bDone ,

Busy=> bBusy ,

Active=> bActive ,

CommandAborted=> bCommandAborted ,

Error=> bError ,

ErrorID=> uwErrorID

);

# 46.6 JOG Operation

## MCv\_Jog

This FB executes JOG operation according to the command velocity.

| Ladder                                                                                                                                                                                                                                                                                                                                                                           | FBD/LD                                                                                                                                                                                                                                                                                                         | ST                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div><div>MCv_Jog</div><div><div>DUT: Axis</div><div>Axis :DUT</div><div>B: JogForward</div><div>Done :B</div><div>B: JogBackward</div><div>Busy :B</div><div>L: Velocity</div><div>Active :B</div><div>L: Acceleration</div><div>CommandAborted :B</div><div>L: Deceleration</div><div>Error :B</div><div>L: Jerk</div><div>ErrorID :UW</div><div>UD: Options</div></div></div> | <div><div>MCv_Jog</div><div><div>JogForward</div><div>Done</div><div>JogBackward</div><div>Busy</div><div>Velocity</div><div>Active</div><div>Acceleration</div><div>CommandAborted</div><div>Deceleration</div><div>Error</div><div>Jerk</div><div>ErrorID</div><div>Options</div><div>Axis</div></div></div> | <div>MCv_Jog(<br/>Axis:= ?AXIS_REF? ,<br/>JogForward:= ?BOOL? ,<br/>JogBackward:= ?BOOL? ,<br/>Velocity:= ?LREAL? ,<br/>Acceleration:= ?LREAL? ,<br/>Deceleration:= ?LREAL? ,<br/>Jerk:= ?LREAL? ,<br/>Options:= ?DWORD? ,<br/>Done=&gt; ?BOOL? ,<br/>Busy=&gt; ?BOOL? ,<br/>Active=&gt; ?BOOL? ,<br/>CommandAborted=&gt; ?BOOL? ,<br/>Error=&gt; ?BOOL? ,<br/>ErrorID=&gt; ?WORD?<br/>);</div> |

## Setting data

### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                                                                                                          |
|--------------|------------------|-----------|----------|-------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br> Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

## ■ Input variable

| Input variable | Name                          | Data type  | Input    | Valid range                    | Default value | Description                                                                                                                                                                                                                                                                                                            |
|----------------|-------------------------------|------------|----------|--------------------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| JogForward     | Positive rotation JOG command | BOOL       | Always   | TRUE, FALSE                    | FALSE         | When this variable is set to TRUE, MCv_Jog (JOG) is executed in the positive direction.<br>For details, refer to the following.<br> Page 1695 Positive rotation JOG command (JogForward)/Reverse rotation JOG command (JogBackward) |
| JogBackward    | Reverse rotation JOG command  | BOOL       | Always   | TRUE, FALSE                    | FALSE         | When this variable is set to TRUE, MCv_Jog (JOG) is executed in the reverse direction.<br>For details, refer to the following.<br> Page 1695 Positive rotation JOG command (JogForward)/Reverse rotation JOG command (JogBackward)  |
| Velocity       | Velocity                      | LREAL      | At start | 0.0, 0.0001 to 2500000000.0    | 0.0           | The command velocity is set.<br>For details, refer to the following.<br> Page 1696 Velocity (Velocity)                                                                                                                              |
| Acceleration   | Acceleration                  | LREAL      | At start | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The acceleration is set.<br>For details, refer to the following.<br> Page 1696 Acceleration (Acceleration)                                                                                                                          |
| Deceleration   | Deceleration                  | LREAL      | At start | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The deceleration is set.<br>For details, refer to the following.<br> Page 1697 Deceleration (Deceleration)                                                                                                                          |
| Jerk           | Jerk                          | LREAL      | At start | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The jerk is set.<br>For details, refer to the following.<br> Page 1697 Jerk (Jerk)                                                                                                                                                  |
| Options        | Options                       | DWORD(HEX) | At start | 00000000H to 00000001H         | 00000000H     | The function options for MCv_Jog (JOG) are set in the specified bit position.<br>For details, refer to the following.<br> Page 1697 Options (Options)                                                                             |

## ■ Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                     |
|-----------------|-----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE only for one scan when a deceleration stop is completed by turning off the JOG command.                                                                                                                              |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MCv_Jog (JOG) is executed.                                                                                                                                                                                      |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MCv_Jog (JOG) is controlling the axis.                                                                                                                                                                         |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MCv_Jog (JOG) is aborted.                                                                                                                                                                          |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |

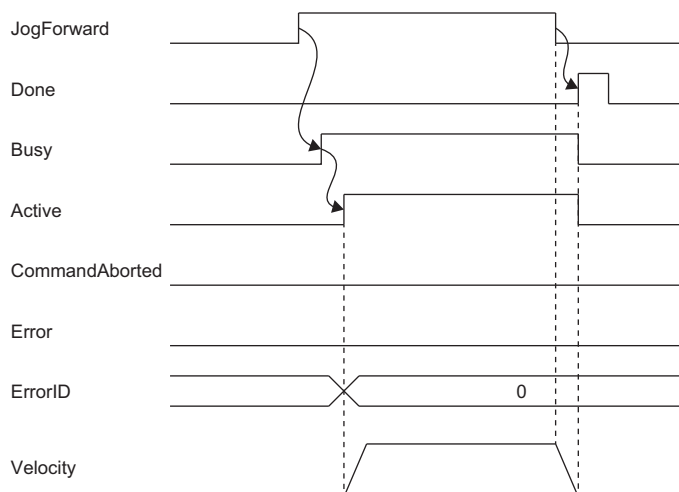
## Processing details

- This FB moves the target axis to the specified direction when Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) is set to TRUE.
- Axis status (AxisName.Md.AxisStatus) is "6: During continuous operation (ContinuousMotion)" during JOG operation.
- A deceleration stop is performed when Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) is set to FALSE.
- Axis status (AxisName.Md.AxisStatus) changes to "4: Standby (Standstill)" at deceleration stop completion.
- If Error (Error) becomes TRUE during deceleration by Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) becoming FALSE, Error (Error) remains TRUE until Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) is set to TRUE.
- When another operation FB is started during JOG operation, the operation is performed based on the setting of Buffer mode (BufferMode) of the started operation FB.
- When JOG operation is started during another operation FB, the start request is ignored and Start during Operation Warning (event code: 00D01H) occurs. Start JOG operation when Axis status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)".
- To change the velocity during JOG operation, use the override function to perform the velocity change. For details on the override function, refer to the following.

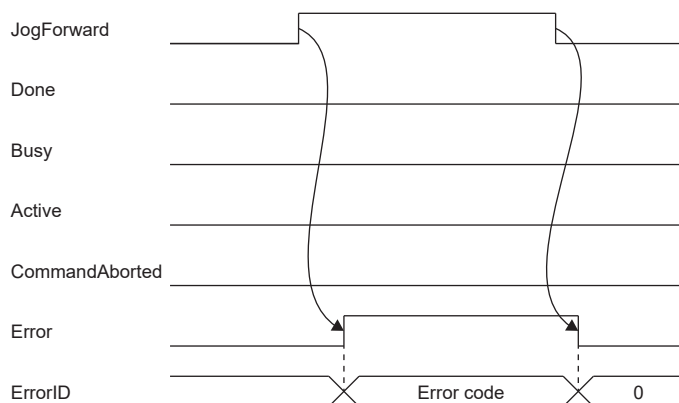
 User's manual for the controller used

### ■ Timing chart

- When the processing is completed successfully



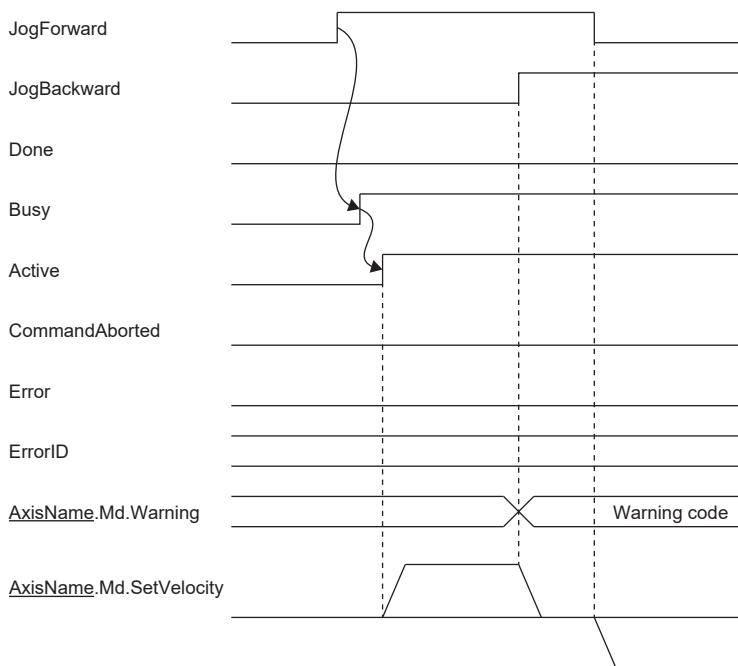
- When the processing is completed with an error



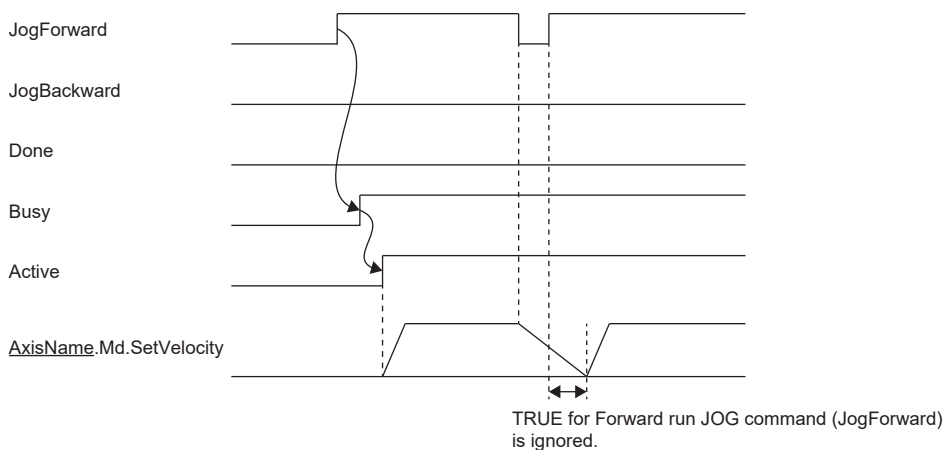


## ■ Positive rotation JOG command (JogForward)/Reverse rotation JOG command (JogBackward)

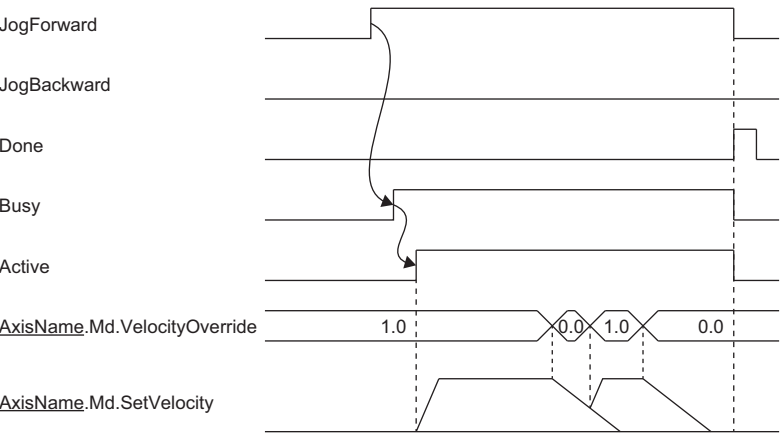
- Setting Positive rotation JOG command (JogForward) to TRUE starts positive rotation JOG operation, and setting Reverse rotation JOG command (JogBackward) to TRUE starts reverse rotation JOG operation, following which the target axis moves in the specified direction.
- If Positive rotation JOG command (JogForward) and Reverse rotation JOG command (JogBackward) are set to TRUE simultaneously, JOG Command Input at Both Directions Warning (event code: 00D02H) occurs, Abortion of execution (CommandAborted) becomes TRUE, and JOG operation will not start. To perform JOG operation, first set the JOG commands for both directions to FALSE and wait for Abortion of execution (CommandAborted) to become FALSE, then set either Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) to TRUE.
- During JOG operation, if the other JOG command (Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward)) of MCv\_JOG (JOG) becomes TRUE, JOG Command Input at Both Directions Warning (event code: 00D02H) occurs and a deceleration stop is performed from the point where the said TRUE was detected. When performing JOG operation, only set either Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) to TRUE. To perform JOG operation, only one of Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) must be set to TRUE.



- During the deceleration stop by Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) becoming FALSE, re-acceleration will not be performed even if the JOG command is set to TRUE. The acceleration will be performed after the deceleration stop is completed.



- To repeatedly perform deceleration stop and acceleration while moving by JOG operation, use the override function to perform the velocity change.



### ■Velocity (Velocity)

Sets the command velocity used in MCv\_Jog (JOG).

The settings are imported when JOG operation is started by Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) becoming TRUE. Changes made during JOG operation are not accepted.

| Setting range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.0, 0.0001 to 2500000000.0 <sup>*1,2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p>*1 To perform floating-point operation, the lower limit value of the command velocity is limited by the following restrictions.<br/>If the velocity converted from the command velocity to operation cycle is less than 0.00001, Out of Operation Cycle Converted Velocity Range (error code: 1B16H) (when changing the velocity, Out of Operation Cycle Converted Velocity Range Warning (event code: 00D2FH)) occurs. To improve the precision of floating-point operation, change Position command unit (<u>AxisName.Pr.Unit_Position</u>) and Speed command unit (<u>AxisName.Pr.Unit_Velocity</u>) and perform settings so that the velocity converted into the operation cycle is not less than "0.00001".</p> <p>*2 When a Motion control FB with a commanded velocity of "0.0" performs a multiple start, the commanded velocity of the previous Motion control FB is used.</p> |

### ■Acceleration (Acceleration)

Sets the acceleration used in MCv\_Jog (JOG).

The settings are imported when JOG operation is started by Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) becoming TRUE. Changes made during JOG operation are not accepted.

The setting range differs depending on the setting for Acceleration/deceleration method setting (Options (Options): Bit 0 to 2).

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | 0.000000 <sup>*1</sup> , positive numbers from 0.000001 to 8400.0[s]                   |

- \*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Deceleration (Deceleration)

Sets the deceleration used in MCv\_Jog (JOG).

The settings are imported when JOG operation is started by Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) becoming TRUE. Changes made during JOG operation are not accepted.

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Deceleration (Deceleration) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                               |

\*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Jerk (Jerk)

Sets the jerk used in MCv\_Jog (JOG).

The settings are imported when JOG operation is started by Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) becoming TRUE. Changes made during JOG operation are not accepted.

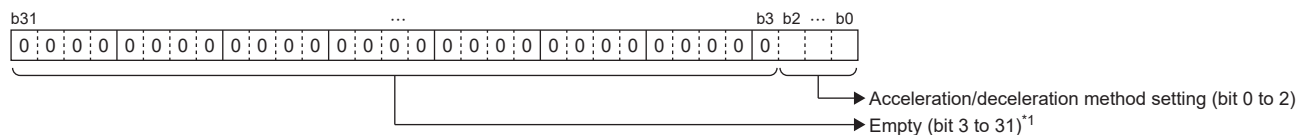
Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Jerk (Jerk) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                           |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000, positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                |

## ■Options (Options)

The function options for MCv\_Jog (JOG) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit    | Name                                     | Description                                                                                                                                                                                            |
|--------|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 2 | Acceleration/deceleration method setting | Sets the acceleration/deceleration method used to perform control.<br>• 0: Acceleration/deceleration specification method (mcAccDec)<br>• 1: Acceleration/deceleration time-fixed method (mcFixedTime) |

### • Acceleration/deceleration method setting (Bit 0 to 2)

| Setting value                                                | Description                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec) | An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) set in MCv_Jog (JOG).                                                                                                                         |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime) | An acceleration/deceleration method using the acceleration/deceleration time specified in MCv_Jog (JOG) regardless of the velocity.<br>The acceleration/deceleration time does not use Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). |

## ■Necessary object data

When using MCv\_Jog (JOG Operation), set the following object data for the axis.

- Target position (607AH)

If the object data is not set, Necessary Slave Object Unset (error code: 1AF7H) occurs and the axis will not start.

For details on object data settings, refer to the following.

📖 User's manual for the controller used

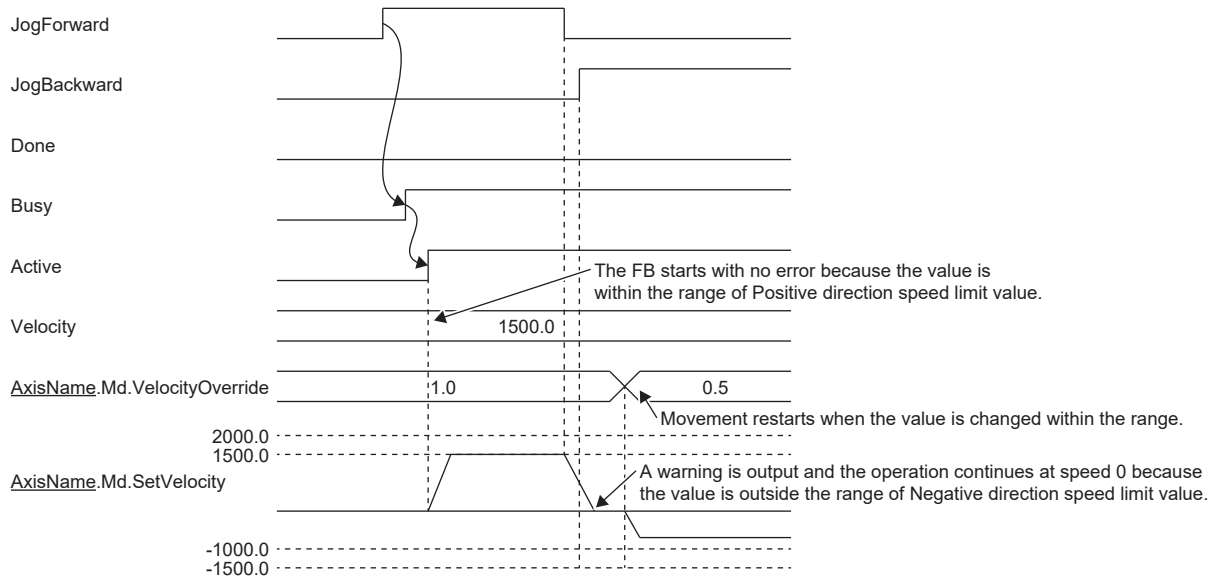
## Precautions

- For safety, first set a small value in Velocity (Velocity) and check the movement, then gradually increase the value.
- Use the hardware stroke limit function when performing JOG operation near the upper limit or lower limit. If the hardware stroke limit function is not used, the workpiece may exceed the moving range and cause an accident.
- When the software stroke limit function is valid and Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit\_Override) is other than DISABLE (Check disabled) or ONLY\_INSIDE (Check disabled only for movement returning to the range), Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit\_Override) is rewritten into ONLY\_INSIDE (Check disabled only for movement returning to the range) during MCv\_Jog (JOG Operation) execution, and it is rewritten into a blank at JOG operation completion.
- When the hardware stroke limit function is valid and Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit\_Override) is other than DISABLE (Check disabled) or ONLY\_INSIDE (Check disabled only for movement returning to the range), Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit\_Override) is rewritten into ONLY\_INSIDE (Check disabled only for movement returning to the range) during MCv\_Jog (JOG Operation) execution, and it is rewritten into a blank at JOG operation completion.
- Do not change Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit\_Override) and Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit\_Override) during MCv\_Jog (JOG) execution.
- When multiple start is executed during JOG operation, the values of Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit\_Override) and Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit\_Override) at the multiple start are retained to the next FB to analyze the next FB.
- When the movement is executed in the opposite direction from that at start after a deceleration stop is performed during JOG operation, and if the command velocity exceeds the velocity limit value, Velocity Limit Value Over Warning on Direction Change (event code: 00D20H) occurs. In addition, when the acceleration time exceeds 8400 seconds, Acceleration Time Over Warning on Direction Change (event code: 00D32H) occurs. (The operation continues at velocity 0.) Movement starts after changing control to remove the cause.

### Ex.

When the following values are set

- Positive Direction Speed Limit Value (AxisName.Pr.VelocityLimit\_Positive): 2000.0
- Negative Direction Speed Limit Value (AxisName.Pr.VelocityLimit\_Negative): 1000.0



## Program example

The following is a program example. The JOG positive rotation command (bJogForward) is set to TRUE for positive rotation JOG operation and the JOG reverse rotation command (bJogBackward) is set to TRUE for reverse rotation JOG operation. Then, JOG operation is performed for Axis 1 (Axis0001).

- Setting

| Item         | Setting value |
|--------------|---------------|
| Velocity     | 1500.0        |
| Acceleration | 2000.0        |
| Deceleration | 2000.0        |
| Jerk         | 0.0           |

### ■Axis

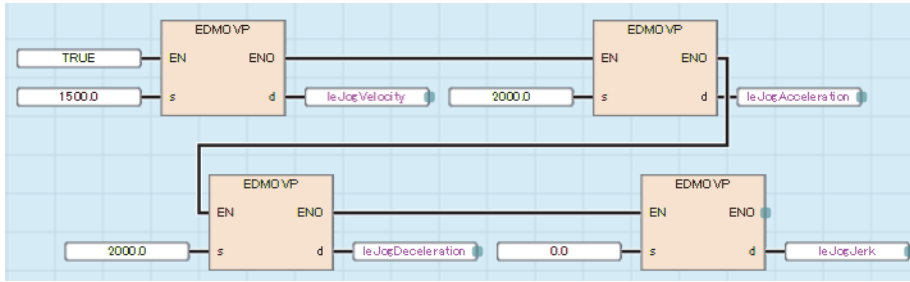
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### ■Labels used

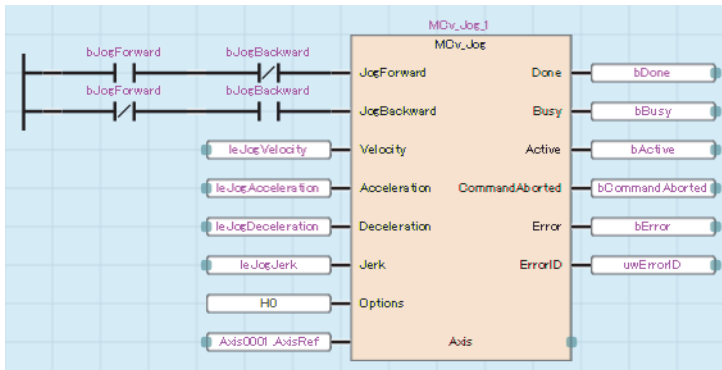
| Label name        | Data type                           | Comment                       |
|-------------------|-------------------------------------|-------------------------------|
| MCv_Jog_1         | MCv_Jog                             | JOG FB                        |
| bJogForward       | Bit                                 | JOG positive rotation command |
| bJogBackward      | Bit                                 | JOG reverse rotation command  |
| leJogVelocity     | Double-precision real number        | JOG velocity                  |
| leJogAcceleration | Double-precision real number        | JOG acceleration              |
| leJogDeceleration | Double-precision real number        | JOG deceleration              |
| leJogJerk         | Double-precision real number        | JOG jerk                      |
| bJogF             | Bit                                 | JOG positive rotation         |
| bJogB             | Bit                                 | JOG reverse rotation          |
| bDone             | Bit                                 | Execution completion          |
| bBusy             | Bit                                 | Executing                     |
| bActive           | Bit                                 | Controlling                   |
| bCommandAborted   | Bit                                 | Abortion of execution         |
| bError            | Bit                                 | Error                         |
| uwErrorID         | Word [unsigned]/bit string [16-bit] | Error code                    |

## ■ FBD/LD program

- Data settings for JOG operation



- Axis0001 JOG operation



## ■ST program

```
//-----Data settings for JOG operation-----
leJogVelocity:= 1500.0;
leJogAcceleration:= 2000.0;
leJogDeceleration:= 2000.0;
leJogJerk:= 0.0;

//-----Axis0001 JOG operation-----
bJogForward:= (bJogForward=TRUE) & (bJogBackward=FALSE);
bJogBackward:= (bJogForward=FALSE) & (bJogBackward=TRUE);

MCv_Jog_1(
  Axis:= Axis0001.AxisRef ,
  JogForward:= bJogForward ,
  JogBackward:= bJogBackward ,
  Velocity:= leJogVelocity ,
  Acceleration:= leJogAcceleration ,
  Deceleration:= leJogDeceleration ,
  Jerk:= leJogJerk ,
  Options:= H00000000 ,
  Done=> bDone ,
  Busy=> bBusy ,
  Active=> bActive ,
  CommandAborted=> bCommandAborted ,
  Error=> bError ,
  ErrorID=> uwErrorID
);
```

# 46.7 Speed Control

## MC\_MoveVelocity

This FB switches the drive unit to csv and performs velocity control according to the specified velocity.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MC_MoveVelocity(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   Velocity:= ?LREAL? ,   Acceleration:= ?LREAL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   Direction:= ?INT? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   InVelocity=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable   | Name              | Data type | Input                                                    | Valid range                    | Default value | Description                                                                                                                                                                                                                                                                                                                                       |
|------------------|-------------------|-----------|----------------------------------------------------------|--------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute          | Execution command | BOOL      | At start                                                 | TRUE, FALSE                    | FALSE         | When this variable is set to TRUE, MC_MoveVelocity (Speed Control) is executed.                                                                                                                                                                                                                                                                   |
| ContinuousUpdate | Continuous update | BOOL      | At start                                                 | TRUE, FALSE                    | FALSE         | Whether to enable or disable continuous change of Velocity (Velocity), Acceleration (Acceleration), and Deceleration (Deceleration) is set.<br>• FALSE: Disabled<br>• TRUE: Enabled                                                                                                                                                               |
| Velocity         | Velocity          | LREAL     | At start/ Retrigger possible/ Continuous update possible | 0.0, ±0.0001 to ±2500000000.0  | 0.0           | The command velocity is set.<br>When the velocity is negative, the axis moves in the negative direction. When "0.0" is set, the axis does not operate, but Axis status ( <u>AxisName</u> .Md.AxisStatus) changes to "6: During continuous operation (ContinuousMotion)".<br>For details, refer to the following.<br>Page 1704 Velocity (Velocity) |
| Acceleration     | Acceleration      | LREAL     | At start/ Retrigger possible/ Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The acceleration is set.<br>For details, refer to the following.<br>Page 1705 Acceleration (Acceleration)                                                                                                                                                                                                                                         |



| Input variable | Name                   | Data type                 | Input                                                                   | Valid range                       | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------|------------------------|---------------------------|-------------------------------------------------------------------------|-----------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Deceleration   | Deceleration           | LREAL                     | At start/<br>Retrigger<br>possible/<br>Continuous<br>update<br>possible | 0.0000, 0.0001 to<br>2147483647.0 | 0.0           | The deceleration is set.<br>For details, refer to the following.<br>Page 1705 Deceleration (Deceleration)                                                                                                                                                                                                                                                                                                                            |
| Jerk           | Jerk                   | LREAL                     | At start                                                                | 0.0000, 0.0001 to<br>2147483647.0 | 0.0           | The jerk is set.<br>For details, refer to the following.<br>Page 1705 Jerk (Jerk)                                                                                                                                                                                                                                                                                                                                                    |
| Direction      | Direction<br>selection | INT<br>(MC_DIREC<br>TION) | At start                                                                | 1, 2                              | 0             | The direction is set.<br><ul style="list-style-type: none"> <li>• 1: Positive direction (mcPositiveDirection)</li> <li>• 2: Negative direction (mcNegativeDirection)</li> </ul> * When "2: Negative direction (mcNegativeDirection)" is set and Velocity (Velocity) is negative, the movement direction of the motor will be positive.<br>* If this setting is omitted, Out of Direction Selection Range (error code: 1AA5H) occurs. |
| BufferMode     | Buffer mode            | INT<br>(MC_BUFFER_MODE)   | At start                                                                | 0, 1                              | 0             | The buffer mode is set.<br><ul style="list-style-type: none"> <li>• 0: Aborting (mcAborting)</li> <li>• 1: Buffered (mcBuffered)</li> </ul> For details, refer to the following.<br>Page 1705 Buffer mode (BufferMode)                                                                                                                                                                                                               |
| Options        | Options                | DWORD(HEX)                | At start                                                                | 00000000H to 0002001H             | 00000000H     | The function options for MC_MoveVelocity (Speed Control) are set in the specified bit position.<br>For details, refer to the following.<br>Page 1706 Options (Options)                                                                                                                                                                                                                                                               |

## ■ Output variables

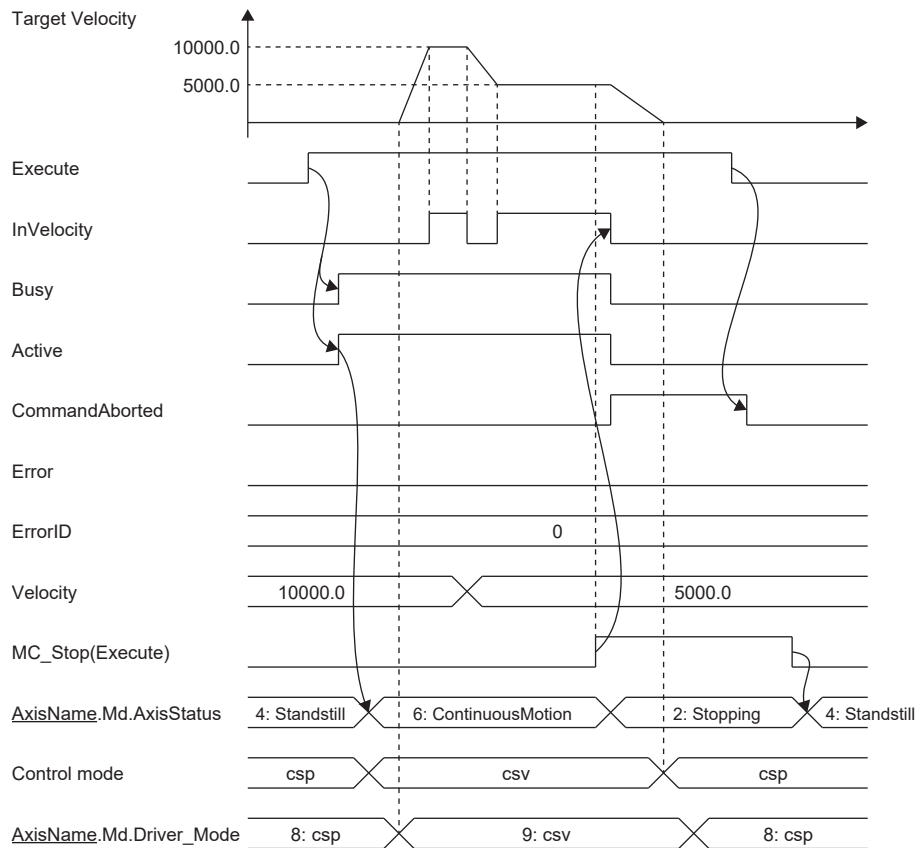
| Output variable | Name                          | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                        |
|-----------------|-------------------------------|------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InVelocity      | Target<br>velocity<br>reached | BOOL       | FALSE         | This variable becomes TRUE when the command velocity calculated by the Motion system reaches the target velocity.<br>When the target velocity has been changed due to change at Continuous update (ContinuousUpdate) TRUE, this variable remains FALSE until the velocity reaches the post-change target velocity. |
| Busy            | Executing                     | BOOL       | FALSE         | This variable becomes TRUE when MC_MoveVelocity (Speed Control) is executed.                                                                                                                                                                                                                                       |
| Active          | Controlling                   | BOOL       | FALSE         | This variable becomes TRUE while MC_MoveVelocity (Speed Control) is controlling the axis.                                                                                                                                                                                                                          |
| CommandAborted  | Abortion of<br>execution      | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_MoveVelocity (Speed Control) is aborted.<br>The variable becomes FALSE when Execution command (Execute) becomes FALSE.                                                                                                                                             |
| Error           | Error                         | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                   |
| ErrorID         | Error code                    | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used                                                                                                                                                        |

## Processing details

MC\_MoveVelocity (Velocity Control) switches the drive unit control mode to csv and performs control. This function controls the command velocity based on the set Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). To finish MC\_MoveVelocity (Speed Control), start MC\_Stop (Forced Stop).

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

📖 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

### ■Velocity (Velocity)

Sets the command velocity used in MC\_MoveVelocity (Speed Control).

#### Setting range

0.0,  $\pm 0.0001$  to  $\pm 25000000000.0^{*1*2}$

- \*1 To perform floating-point operation, the lower limit value of the command velocity is limited by the following restrictions.  
If the velocity converted from the command velocity to operation cycle is less than 0.00001, Out of Operation Cycle Converted Velocity Range (error code: 1B16H) (when changing the velocity, Out of Operation Cycle Converted Velocity Range Warning (event code: 00D2FH)) occurs. To improve the precision of floating-point operation, change Position command unit (AxisName.Pr.Unit\_Position) and Speed command unit (AxisName.Pr.Unit\_Velocity) and perform settings so that the velocity converted into the operation cycle is not less than "0.00001".
- \*2 When a Motion control FB with a commanded velocity of "0.0" performs a multiple start, the commanded velocity of the previous Motion control FB is used.

## ■Acceleration (Acceleration)

Sets the acceleration used in MC\_MoveVelocity (Speed Control).

The setting range differs depending on the setting for Acceleration/deceleration method setting (Options (Options): Bit 0 to 2).

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | 0.000000 <sup>*1</sup> , positive numbers from 0.000001 to 8400.0[s]                   |

\*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Deceleration (Deceleration)

Sets the deceleration used in MC\_MoveVelocity (Speed Control).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Deceleration (Deceleration) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                               |

\*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Jerk (Jerk)

Sets the jerk used in MC\_MoveVelocity (Speed Control).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Jerk (Jerk) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                           |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000, positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                |

## ■Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following buffer modes are settable in MC\_MoveVelocity (Speed Control).

| Setting value            | Description                                                                                                                                                                                                                                       |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting) | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                       |
| 1: Buffered (mcBuffered) | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB. |



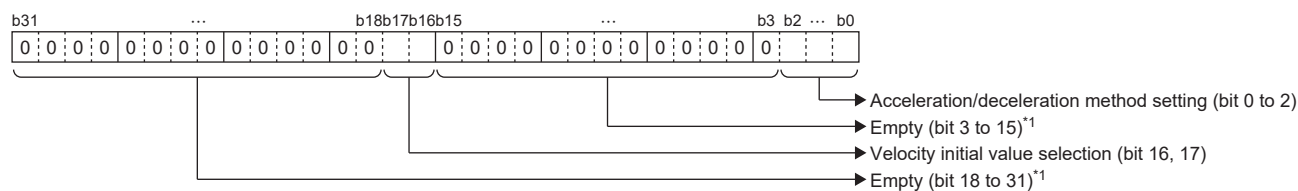
For details on multiple start (buffer mode), refer to the following.

User's manual for the controller used

## ■Options (Options)

The function options for MC\_MoveVelocity (Speed Control) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit    | Name                                     | Description                                                                                                                                                                                                                                                                                    |
|--------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 2 | Acceleration/deceleration method setting | Sets the acceleration/deceleration method used to perform control. <ul style="list-style-type: none"> <li>0: Acceleration/deceleration specification method (mcAccDec)</li> <li>1: Acceleration/deceleration time-fixed method (mcFixedTime)</li> </ul>                                        |
| 16, 17 | Velocity initial value selection         | The velocity initial value used when changing the control mode from cyclic synchronous position mode (csp) to cyclic synchronous velocity mode (csv) is set. <ul style="list-style-type: none"> <li>0: Command velocity</li> <li>1: Actual velocity</li> <li>2: Automatic selection</li> </ul> |

### • Acceleration/deceleration method setting (Bit 0 to 2)

| Setting value                                                | Description                                                                                                                                                                                                                                                                         |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec) | An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) set in MC_MoveVelocity (Speed Control)                                                                                                                          |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime) | An acceleration/deceleration method using the acceleration/deceleration time specified in MC_MoveVelocity (Speed Control) regardless of the velocity.<br>The acceleration/deceleration time does not use Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). |

### • Velocity initial value selection (Bit 16, 17)

| Setting value          | Description                                                                                                                                                  |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Command velocity    | The velocity during command is used as the velocity commanded to the drive unit immediately after switching.                                                 |
| 1: Actual velocity     | The motor speed received from the drive unit at switching is used.*1                                                                                         |
| 2: Automatic selection | The lower velocity between "0: Command velocity" and "1: Actual velocity" is used as the velocity commanded to the drive unit immediately after switching.*2 |

\*1 When object data "Velocity actual value (606CH)" is not mapped, the motor speed received from the drive unit at switching is not used. (Speed initial value selection becomes "0".)

\*2 When object data "Velocity actual value (606CH)" is not mapped, the velocity commanded to the drive unit immediately after switching becomes "0: Command velocity".

## ■Related object data

The following table lists the functions that cause errors or specification restrictions when no object data is set, no PDO is mapped, or when there is no object in the device station.

For details on object data settings, refer to the following.

📖 User's manual for the controller used

◎: Required, ○: Recommended

| Instruction/function            | Required object data  | PDO mapping | Operation when the object is not set                                                                                  |
|---------------------------------|-----------------------|-------------|-----------------------------------------------------------------------------------------------------------------------|
| MC_MoveVelocity (Speed Control) | Target velocity       | ◎           | Necessary Object Data Unset (error code: 1AF7H) occurs.                                                               |
|                                 | Velocity actual value | ○           | Operation set in Velocity initial value selection (Options (Options) bit: 16 and 17)<br>📖 Page 1706 Options (Options) |

## Precautions

- Velocity Override Factor (AxisName.Cd.VelocityOverride) and Acceleration Override Factor (AxisName.Cd.AccelerationOverride) are valid.
  - The set position and the feed machine position are updated by follow up.
  - The switching time of the control mode depends on the specifications of the drive unit.
  - When the stop cause occurs during the control mode switching, the axis will stop immediately.
  - Do not start a positioning control FB while switching the control mode. Check that Driver control mode (AxisName.Md.Driver\_Mode) has switched to "9: Velocity control (csv)" before starting a positioning control FB.
  - When the control mode is switched from cyclic synchronous position mode (csp) to cyclic synchronous velocity mode (csv), follow-up may be performed in cyclic synchronous position mode (csp) until the axis reaches a zero velocity state, if a stop factor (axis error detection) occurs before the control mode is switched.
  - Note the following precautions when using MR-J5(W)-G and switching from csp to csv without waiting for the motor to stop, or when switching from csv to csp.
    - Set servo parameter (extension setting) "ZSP disabled selection at control switching (PC76.1)" to "1: Disabled (control switching is performed regardless of the range of ZSP)" and disable monitoring of zero speed status. Note that doing so may cause vibration or impact to occur at control mode switching.
    - For the setting values of servo parameters (basic setting) "Electronic gear numerator (PA06)" and "Electronic gear denominator (PA07)", refer to the following.
-  User's manual for the controller used

## Processing details

The following is a program example. The speed control command (bMoveVelocity) is set to TRUE, the mode is switched to velocity mode, and speed control is performed for Axis 1 (Axis0001).

- Setting

| Item         | Setting value |
|--------------|---------------|
| Velocity     | 100000.0      |
| Acceleration | 50000.0       |
| Deceleration | 50000.0       |
| Jerk         | 0.0           |

### ■Axis

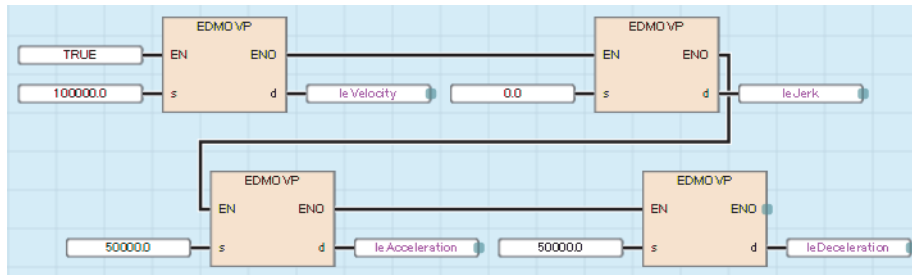
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### ■Labels used

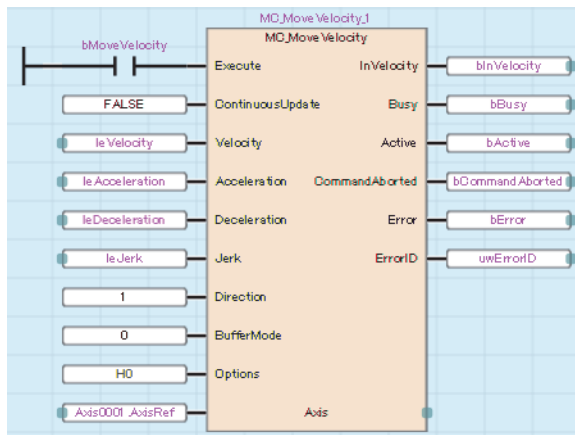
| Label name        | Data type                           | Comment                 |
|-------------------|-------------------------------------|-------------------------|
| MC_MoveVelocity_1 | MC_MoveVelocity                     | Speed Control FB        |
| bMoveVelocity     | Bit                                 | Speed control command   |
| leVelocity        | Double-precision real number        | Command velocity        |
| leAcceleration    | Double-precision real number        | Acceleration            |
| leDeceleration    | Double-precision real number        | Deceleration            |
| leJerk            | Double-precision real number        | Jerk                    |
| bInVelocity       | Bit                                 | Target velocity reached |
| bBusy             | Bit                                 | Executing               |
| bActive           | Bit                                 | Controlling             |
| bCommandAborted   | Bit                                 | Abortion of execution   |
| bError            | Bit                                 | Error                   |
| uwErrorID         | Word [unsigned]/bit string [16-bit] | Error code              |

## ■ FBD/LD program

- Data settings for speed control



- Speed Control



## ■ST program

//-----Data settings for speed control-----

leVelocity:= 100000.0;

leAcceleration:= 50000.0;

leDeceleration:= 50000.0;

leJerk:= 0.0;

//-----Speed Control-----

```
MC_MoveVelocity_1(
  Axis:= Axis0001.AxisRef ,
  Execute:= bMoveVelocity ,
  ContinuousUpdate:= FALSE ,
  Velocity:= leVelocity ,
  Acceleration:= leAcceleration ,
  Deceleration:= leDeceleration ,
  Jerk:= leJerk ,
  Direction:= MC_DIRECTION__mcPositiveDirection ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= H00000000 ,
  InVelocity=> bInVelocity ,
  Busy=> bBusy ,
  Active=> bActive ,
  CommandAborted=> bCommandAborted ,
  Error=> bError ,
  ErrorID=> uwErrorID
);
```

# 46.8 Torque Control

## MC\_TorqueControl

This FB switches the drive unit to cst and performs torque control according to the specified target torque.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MC_TorqueControl(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   Torque:= ?LREAL? ,   TorquePositiveRamp:= ?LREAL? ,   TorqueNegativeRamp:= ?LREAL? ,   LimitVelocity:= ?LREAL? ,   Acceleration:= ?LREAL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   Direction:= ?INT? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   InTorque=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable    | Name              | Data type | Input                                                          | Valid range           | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------|-------------------|-----------|----------------------------------------------------------------|-----------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute           | Execution command | BOOL      | At start                                                       | TRUE, FALSE           | FALSE         | When this variable is set to TRUE, MC_TorqueControl (Torque Control) is executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Continuous Update | Continuous update | BOOL      | At start                                                       | TRUE, FALSE           | FALSE         | Whether to enable or disable continuous change of Target torque (Torque), Torque positive direction ramp (TorquePositiveRamp), Torque negative direction ramp (TorqueNegativeRamp), Limit velocity (LimitVelocity), Acceleration (Acceleration), and Deceleration (Deceleration) is set.<br>• FALSE: Disabled<br>• TRUE: Enabled                                                                                                                                                                                                       |
| Torque            | Target torque     | LREAL     | At start/<br>Retrigger possible/<br>Continuous update possible | -1000.0 to 1000.0 [%] | 0.0           | The command torque is set.<br>The ratio of the servo motor used to the rated torque is set in percentage.<br>The number of significant digits after the decimal point differs depending on the ID assigned to the object data map.<br>Values less than the number of significant digits are rounded down.<br>To output the command torque in the positive direction (address increasing direction), set a positive value. To output the command torque in the negative direction (address decreasing direction), set a negative value. |



| Input variable     | Name                           | Data type            | Input                                                          | Valid range                                                                                                                                   | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------|--------------------------------|----------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TorquePositiveRamp | Torque positive direction ramp | LREAL                | At start/<br>Retrigger possible/<br>Continuous update possible | ■When "0: Ramp method" is set<br>0.0 to 1000.0 [%/s]<br>■When "1: Time constant method" or "2: Fixed time method" is set<br>0.0 to 8400.0 [s] | 0.0           | The positive direction command torque is set.<br>For details, refer to the following.<br>☞ Page 1713 Torque positive direction ramp (TorquePositiveRamp)/Torque negative direction ramp (TorqueNegativeRamp)                                                                                                                                                                                                                                                                                                                                                                                |
| TorqueNegativeRamp | Torque negative direction ramp | LREAL                | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0 to 8400.0 [s]                                                                                                                             | 0.0           | The negative direction command torque is set.<br>☞ Page 1713 Torque positive direction ramp (TorquePositiveRamp)/Torque negative direction ramp (TorqueNegativeRamp)                                                                                                                                                                                                                                                                                                                                                                                                                        |
| LimitVelocity      | Limit velocity                 | LREAL                | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0001 to 2500000000.0                                                                                                                        | 0.0           | The velocity limit value for the cyclic synchronous torque mode is set.<br>*: For the velocity limit value, refer to the manual for the drive unit.<br>■When the MR-J5(W)-G is used<br>• Use the object data "Velocity limit value (2D20H)" as the velocity limit value.<br>• When the object data "Velocity limit value (2D20H)" is not mapped, velocity commands from the controller will not be enabled. (The setting value of the servo parameter "Speed limit (PT67)" is enabled.)<br>* For details on object data, refer to the following.<br>☞ User's manual for the controller used |
| Acceleration       | Acceleration                   | LREAL                | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0                                                                                                                | 0.0           | The acceleration and acceleration/deceleration time used until the limit velocity is reached is set.<br>For details, refer to the following.<br>☞ Page 1714 Acceleration (Acceleration)                                                                                                                                                                                                                                                                                                                                                                                                     |
| Deceleration       | Deceleration                   | LREAL                | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0                                                                                                                | 0.0           | The deceleration used until the limit velocity is reached is set.<br>For details, refer to the following.<br>☞ Page 1714 Deceleration (Deceleration)                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Jerk               | Jerk                           | LREAL                | At start                                                       | 0.0000, 0.0001 to 2147483647.0                                                                                                                | 0.0           | The jerk used until the limit velocity is reached is set.<br>For details, refer to the following.<br>☞ Page 1714 Jerk (Jerk)<br>* When "0.0" is set or this setting is omitted, the jerk is not applied.                                                                                                                                                                                                                                                                                                                                                                                    |
| Direction          | Direction selection            | INT (MC_DIRECTION)   | At start                                                       | 0                                                                                                                                             | 0             | Set "0".<br>* If a value other than "0" is set, Out of Direction Selection Range (error code: 1AA5H) occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| BufferMode         | Buffer mode                    | INT (MC_BUFFER_MODE) | At start                                                       | 0, 1                                                                                                                                          | 0             | The buffer mode is set.<br>• 0: Aborting (mcAborting)<br>• 1: Buffered (mcBuffered)<br>For details, refer to the following.<br>☞ Page 1714 Buffer mode (BufferMode)                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Options            | Options                        | DWORD(H EX)          | At start                                                       | 00000000H to 00060001H                                                                                                                        | 00000000H     | The function options for MC_TorqueControl (Torque Control) are set in the specified bit position.<br>For details, refer to the following.<br>☞ Page 1715 Options (Options)                                                                                                                                                                                                                                                                                                                                                                                                                  |

## ■Output variables

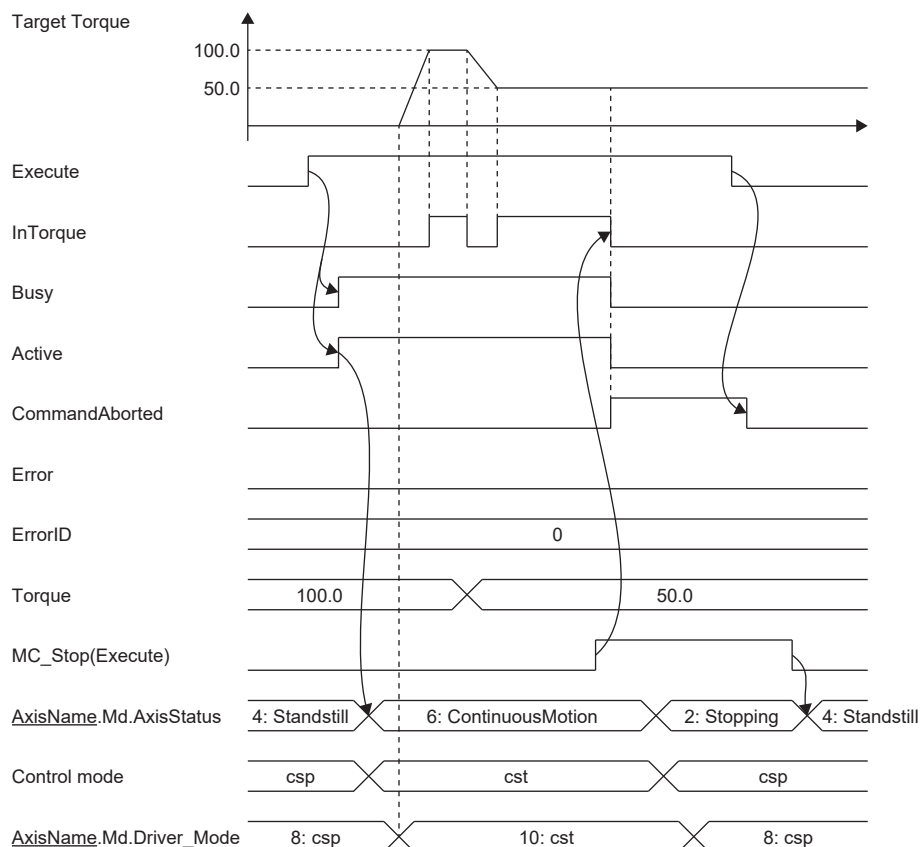
| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                                   |
|-----------------|-----------------------|------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InTorque        | Target torque reached | BOOL       | FALSE         | This variable becomes TRUE when the command torque is reached.<br>When the target torque has been changed due to change at Continuous update (ContinuousUpdate) TRUE, this variable remains FALSE until the set torque reaches the post-change target torque. |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MC_TorqueControl (Torque Control) is executed.                                                                                                                                                                                |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MC_TorqueControl (Torque Control) is controlling the axis.                                                                                                                                                                   |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_TorqueControl (Torque Control) is aborted.<br>The variable becomes FALSE when Execution command (Execute) becomes FALSE.                                                                                      |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                              |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used                                                                                                   |

## Processing details

MC\_TorqueControl (Torque Control) switches the drive unit control mode to cst (cyclic synchronous torque mode) and performs control. This function controls the command torque based on the specified Torque positive direction ramp (TorquePositiveRamp) and Torque negative direction ramp (TorqueNegativeRamp). To finish MC\_TorqueControl (Torque Control), start MC\_Stop (Forced Stop).

## ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

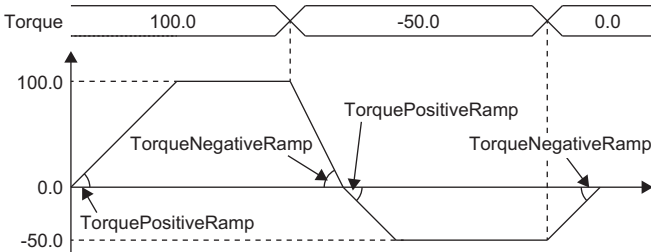
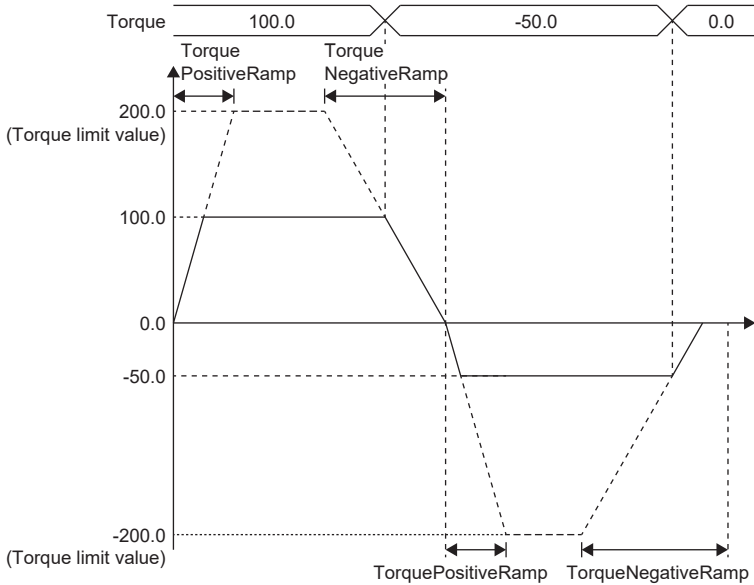
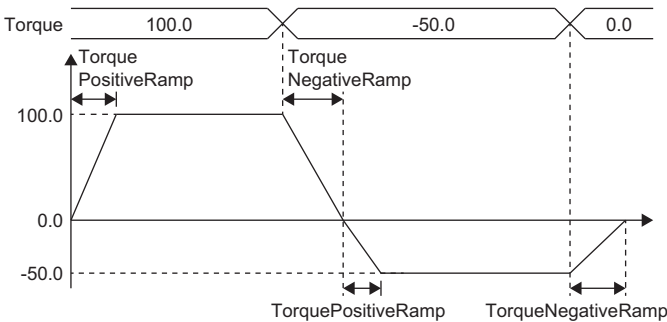
Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■Torque positive direction ramp (TorquePositiveRamp)/Torque negative direction ramp(TorqueNegativeRamp)

Set the command torque to be specified.

Set the setting value used from the current command torque until the target torque is reached.

The setting value used until the target torque is reached differs depending on the setting of Torque ramp function selection (Options (Options): Bit 16, 17).

| Torque ramp function selection<br>(Options (Options): Bit 16, 17) | Description                                                                                                                                                                                           | Setting range       |
|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 0: Ramp method                                                    | <p>Set the ramp from the current command torque until the target torque is reached.</p>                             | 0.0 to 1000.0 [%/s] |
| 1: Time constant method                                           | <p>Set the time from "0" until the command torque reaches either the positive or negative torque limit value.</p>  | 0.0 to 8400.0 [s]   |
| 2: Fixed time method                                              | <p>Set the time from the current command torque until the target torque is reached.</p>                           | 0.0 to 8400.0 [s]   |

When the output torque direction is changed due to the target torque change, the command torque becomes "0.0" based on the setting value of Torque negative direction ramp (TorqueNegativeRamp). After that, the command torque becomes the target torque based on the setting value of Torque positive direction ramp (TorquePositiveRamp).

When Torque positive direction ramp (TorquePositiveRamp) and Torque negative direction ramp (TorqueNegativeRamp) are set to "0.0", the value reaches the target torque in one operation cycle.

## ■Acceleration (Acceleration)

Sets the acceleration used in MC\_TorqueControl (Torque Control).

The setting range differs depending on the setting for Acceleration/deceleration method setting (Options (Options): Bit 0 to 2).

| Acceleration/deceleration method setting<br>(Options (Options): Bit 0 to 2) | Setting range                                                                          |
|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method<br>(mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method<br>(mcFixedTime)             | 0.000000 <sup>*1</sup> , positive numbers from 0.000001 to 8400.0[s]                   |

\*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Deceleration (Deceleration)

Sets the deceleration used in MC\_TorqueControl (Torque Control).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Deceleration (Deceleration) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting<br>(Options (Options): Bit 0 to 2) | Setting range                                                                          |
|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method<br>(mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method<br>(mcFixedTime)             | Not used                                                                               |

\*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Jerk (Jerk)

Sets the jerk used in MC\_TorqueControl (Torque Control).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Jerk (Jerk) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting<br>(Options (Options): Bit 0 to 2) | Setting range                                                           |
|-----------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method<br>(mcAccDec)             | 0.0000, positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method<br>(mcFixedTime)             | Not used                                                                |

## ■Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following buffer modes are settable in MC\_TorqueControl (TorqueControl).

| Setting value            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting) | Aborts (cancels) the under-control FB and executes the next FB immediately.<br>Switches to torque control immediately.                                                                                                                                                                                                                                                                                                                                                        |
| 1: Buffered (mcBuffered) | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB.<br>Switches to torque control after the processing of the previous FB is completed.<br>When the previous FB is MC_TorqueControl (Torque Control), switches to torque control when Target torque reached (InTorque) is TRUE. |



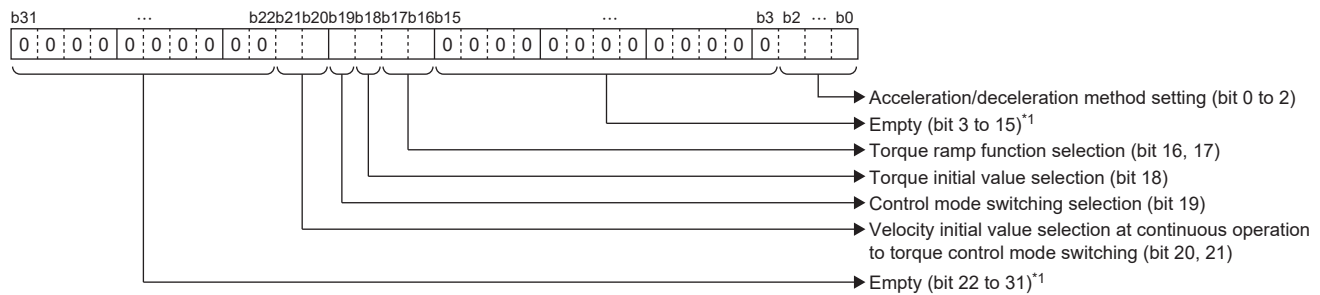
For details on multiple start (buffer mode), refer to the following.

User's manual for the controller used

## ■Options (Options)

The function options for MC\_TorqueControl (Torque Control) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*<sup>1</sup> Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit    | Name                                                                                                             | Description                                                                                                                                                                                                                                                                                                                                                                           |
|--------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 2 | Acceleration/<br>deceleration method<br>setting                                                                  | Sets the acceleration/deceleration method used to perform control. <ul style="list-style-type: none"> <li>0: Acceleration/deceleration specification method (mcAccDec)</li> <li>1: Acceleration/deceleration time-fixed method (mcFixedTime)</li> </ul>                                                                                                                               |
| 16, 17 | Torque ramp function<br>selection                                                                                | Sets the method used from the command torque until the target torque is reached. <ul style="list-style-type: none"> <li>0: Ramp method</li> <li>1: Time constant method</li> <li>2: Fixed time method</li> </ul> <p>* For details, refer to the following.<br/>  Page 1713 Torque positive direction ramp (TorquePositiveRamp)/Torque negative direction ramp(TorqueNegativeRamp)</p> |
| 18     | Torque initial value<br>selection                                                                                | Sets the torque initial value when switching to cyclic synchronous torque mode (cst). <ul style="list-style-type: none"> <li>0: Target torque</li> <li>1: Actual torque</li> </ul>                                                                                                                                                                                                    |
| 19     | Control mode switching<br>selection* <sup>2</sup>                                                                | Sets the switching control mode. <ul style="list-style-type: none"> <li>0: cst (cyclic synchronous torque mode)</li> <li>1: ct (continuous operation to torque control mode)</li> </ul>                                                                                                                                                                                               |
| 20, 21 | Velocity initial value<br>selection at continuous<br>operation to torque<br>control mode switching* <sup>3</sup> | Sets the velocity initial value when changing the control mode from cyclic synchronous position mode (csp) to continuous operation to torque control mode (ct). <ul style="list-style-type: none"> <li>0: Command velocity</li> <li>1: Actual velocity</li> <li>2: Automatic selection</li> </ul>                                                                                     |

\*<sup>2</sup> Switching to continuous operation to torque mode is possible when "Supported drive modes (Obj. 6502Hh) (Bit 20)" of the object data is TRUE. When this bit is set to "1: ct (Continuous operation to torque control mode)" while "Supported drive modes (6502Hh) (Bit 20)" is FALSE, Driver Control Mode Unsupported (error code: 1B1BH) occurs.

For details on continuous operation to torque control mode, refer to the following.

User's manual for the controller used

\*<sup>3</sup> Enabled only when Control mode switching selection (Options (Options): Bit 19) is set to "1: ct (Continuous operation to torque control mode)".

### • Acceleration/deceleration method setting (Bit 0 to 2)

| Setting value                                                   | Description                                                                                                                                                                                                                                                                           |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration<br>specification method (mcAccDec) | An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) set in MC_TorqueControl (Torque Control)                                                                                                                          |
| 1: Acceleration/deceleration time-fixed<br>method (mcFixedTime) | An acceleration/deceleration method using the acceleration/deceleration time specified in MC_TorqueControl (Torque Control) regardless of the velocity.<br>The acceleration/deceleration time does not use Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). |

• Torque initial value selection (Bit 18)

| Setting value    | Description                                                                                                                                                                                                                                             |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Target torque | Target torque (Torque) value at start is set as the command torque immediately after switching the control mode, regardless of the value in Torque positive direction ramp (TorquePositiveRamp) or Torque negative direction ramp (TorqueNegativeRamp). |
| 1: Actual torque | The value of Torque actual value at switching is set as the command torque.*1                                                                                                                                                                           |

\*1 When an object assigned to object data "Torque actual value" is not mapped to PDO, the actual torque received from the drive unit at switching is not used. "0" is used as the torque initial value.

**Point**

Normally, set this bit to "0: Target torque". Set "1: Actual torque" only when switching the control mode immediately after the command to the motor is completed without waiting for the servo motor to stop.

• Velocity initial value selection at continuous operation to torque control mode switching (Bit 20, 21)

| Setting value          | Description                                                                                                                                                  |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Command velocity    | The velocity during command is used as the velocity commanded to the drive unit immediately after switching.                                                 |
| 1: Actual velocity     | The motor speed received from the drive unit at switching is used.*1                                                                                         |
| 2: Automatic selection | The lower velocity between "0: Command velocity" and "1: Actual velocity" is used as the velocity commanded to the drive unit immediately after switching.*2 |

\*1 When object data "Velocity actual value (606CH)" is not mapped, the motor speed received from the drive unit at switching is not used. (Speed initial value selection becomes "0".)

\*2 When object data "Velocity actual value (606CH)" is not mapped, the velocity commanded to the drive unit immediately after switching becomes "0: Command velocity".

## ■Related object data

The following table lists the functions that cause errors or specification restrictions when no object data is set, no PDO is mapped, or when there is no object in the device station.

For details on object data settings, refer to the following.

User's manual for the controller used

◎: Required, ○: Recommended

| Instruction/function                                                 | Required object data  | PDO mapping | Operation when the object is not set                                                                                |
|----------------------------------------------------------------------|-----------------------|-------------|---------------------------------------------------------------------------------------------------------------------|
| MC_TorqueControl (Torque Control)<br>(Control mode switching*1: cst) | Target torque         | ◎           | Necessary Object Data Unset (error code: 1AF7H) occurs.                                                             |
|                                                                      | Velocity limit value  | ○           | Velocity limit during cst using LimitVelocity is invalid.                                                           |
|                                                                      | Torque actual value   | ○           | Operation set in Torque initial value selection (Options (Options) bit: 18)<br>Page 1715 Options (Options)          |
| MC_TorqueControl (Torque Control)<br>(Control mode switching*1: ct)  | Target torque         | ◎           | Necessary Object Data Unset (error code: 1AF7H) occurs.                                                             |
|                                                                      | Velocity limit value  | ◎           | Necessary Object Data Unset (error code: 1AF7H) occurs.                                                             |
|                                                                      | Torque actual value   | ○           | Operation set in Torque initial value selection (Options (Options) bit: 18)<br>Page 1715 Options (Options)          |
|                                                                      | Velocity actual value | ○           | Operation set in Velocity initial value selection (Options (Options) bit: 16 and 17)<br>Page 1706 Options (Options) |

\*1 The item can be set in Control mode switching selection (Options bit 19)

## Precautions

- Velocity Override Factor (AxisName.Cd.VelocityOverride) and Acceleration Override Factor (AxisName.Cd.AccelerationOverride) are valid.
- The set position and the feed machine position are updated by follow up.
- The switching time of the control mode depends on the specifications of the drive unit.
- When the stop cause occurs during the control mode switching, the axis will stop immediately.
- Do not start a positioning control FB while switching the control mode. Check that Driver control mode (AxisName.Md.Driver\_Mode) has switched to "10: Torque control (cst)" before starting the positioning control FB.
- When the control mode is switched from cyclic synchronous position mode (csp) to cyclic synchronous velocity mode (csv), follow-up may be performed in cyclic synchronous position mode (csp) until the axis reaches a zero velocity state, if a stop factor (axis error detection) occurs before the control mode is switched.
- Note the following precautions when using MR-J5(W)-G and switching from csp to cst without waiting for the motor to stop, or when switching from cst to csp.
  - Set servo parameter (extension setting) "ZSP disabled selection at control switching (PC76.1)" to "1: Disabled (control switching is performed regardless of the range of ZSP)" and disable monitoring of zero speed status. Note that doing so may cause vibration or impact to occur at control mode switching.
  - For the setting values of servo parameters (basic setting) "Electronic gear numerator (PA06)" and "Electronic gear denominator (PA07)", refer to the following.
-  User's manual for the controller used
- When Velocity limit value is not mapped, the command torque is changed to 0 when a stop cause occurs.

### ■Torque limit change during cyclic synchronous torque mode (cst)

- At restart or continuous update, if the target torque is changed to a value greater than the torque limit value (Positive direction torque limit value (AxisName.Md.TorqueLimit\_Positive), Negative direction torque limit value (AxisName.Md.TorqueLimit\_Negative)), Torque Limit Value Over Warning (event code: 00D12H) occurs and the axis operates at the value before change.
- During torque control, if Positive direction torque limit value (AxisName.Cd.TorqueLimit\_Positive), Negative direction torque limit value (AxisName.Cd.TorqueLimit\_Negative) are changed to a value smaller than the target torque, the target torque will be changed to the torque limit value. In this case, the command torque is changed in one cycle.

## Program example

The following is a program example. The torque control command (bTorqueControl) is set to TRUE, the mode is switched to torque mode, and torque control is performed for Axis 1 (Axis0001).

- Settings

| Item         | Setting value |
|--------------|---------------|
| Velocity     | 100000.0      |
| Acceleration | 50000.0       |
| Deceleration | 50000.0       |
| Jerk         | 0.0           |

### ■Axis

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

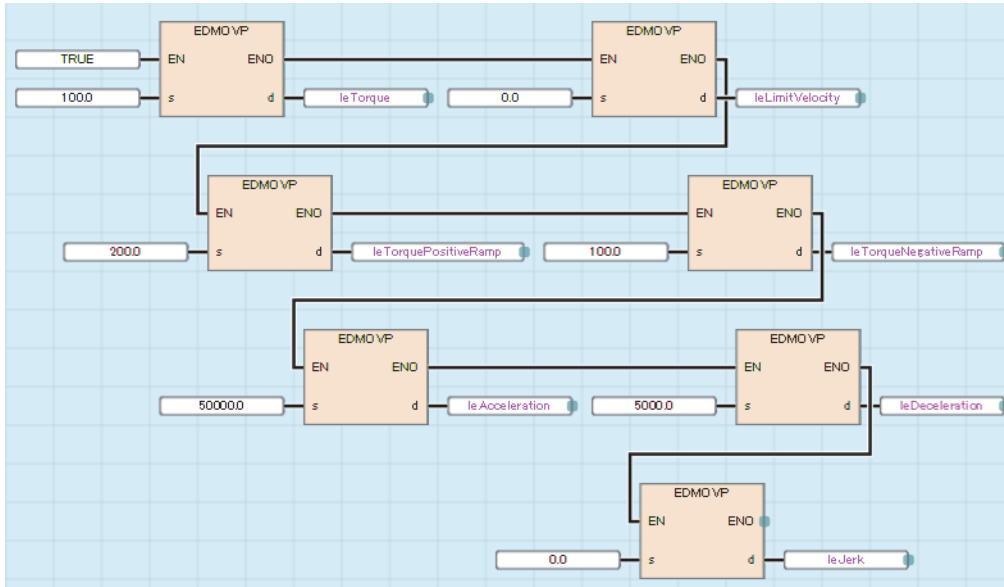
### ■Labels used

| Label name           | Data type                           | Comment                        |
|----------------------|-------------------------------------|--------------------------------|
| MC_TorqueControl_1   | MC_TorqueControl                    | Torque Control FB              |
| bTorqueControl       | Bit                                 | Torque control command         |
| leTorque             | Double-precision real number        | Target torque                  |
| leTorquePositiveRamp | Double-precision real number        | Torque positive direction ramp |
| leTorqueNegativeRamp | Double-precision real number        | Torque negative direction ramp |
| leLimitVelocity      | Double-precision real number        | Limit velocity                 |
| leAcceleration       | Double-precision real number        | Acceleration                   |
| leDeceleration       | Double-precision real number        | Deceleration                   |
| leJerk               | Double-precision real number        | Jerk                           |
| bInTorque            | Bit                                 | Target torque reached          |
| bBusy                | Bit                                 | Executing                      |
| bActive              | Bit                                 | Controlling                    |
| bCommandAborted      | Bit                                 | Abortion of execution          |
| bError               | Bit                                 | Error                          |
| uwErrorID            | Word [unsigned]/bit string [16-bit] | Error code                     |

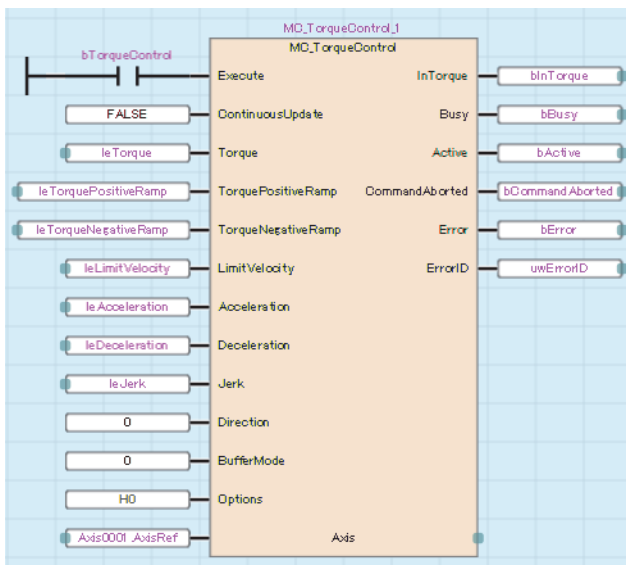


## ■ FBD/LD program

- Data setting for Torque Control



- Torque Control



## ■ST program

//-----Data setting for Torque Control-----

```
leTorque:= 100.0;
leTorquePositiveRamp:= 200.0;
leTorqueNegativeRamp:= 100.0;
leLimitVelocity:= 100000.0;
leAcceleration:= 50000.0;
leDeceleration:= 50000.0;
leJerk:= 0.0;
```

//-----Torque Control-----

```
MC_TorqueControl_1(
  Axis:= Axis0001.AxisRef ,
  Execute:= bTorqueControl ,
  ContinuousUpdate:= FALSE ,
  Torque:= leTorque ,
  TorquePositiveRamp:= leTorquePositiveRamp ,
  TorqueNegativeRamp:= leTorqueNegativeRamp ,
  LimitVelocity:= leLimitVelocity ,
  Acceleration:= leAcceleration ,
  Deceleration:= leDeceleration ,
  Jerk:= leJerk ,
  Direction:= 0 ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= H00000000 ,
  InTorque=> bInTorque ,
  Busy=> bBusy ,
  Active=> bActive ,
  CommandAborted=> bCommandAborted ,
  Error=> bError ,
  ErrorID=> uwErrorID
);
```

# 46.9 Speed Control (Including Position Loop)

46

## MCv\_SpeedControl

This FB performs speed control including the position loop.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MCv_SpeedControl(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   Velocity:= ?LREAL? ,   Acceleration:= ?LREAL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   Direction:= ?INT? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   InVelocity=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable   | Name              | Data type | Input                                                    | Valid range                    | Default value | Description                                                                                                                                                                                                                                                                                                                                                    |
|------------------|-------------------|-----------|----------------------------------------------------------|--------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute          | Execution command | BOOL      | At start                                                 | TRUE, FALSE                    | FALSE         | When this variable is set to TRUE, MCv_SpeedControl (Speed Control (Including Position Loop)) is executed.                                                                                                                                                                                                                                                     |
| ContinuousUpdate | Continuous update | BOOL      | At start                                                 | TRUE, FALSE                    | FALSE         | Whether to enable or disable continuous change of Velocity (Velocity), Acceleration (Acceleration), and Deceleration (Deceleration) is set.<br>• FALSE: Disabled<br>• TRUE: Enabled                                                                                                                                                                            |
| Velocity         | Velocity          | LREAL     | At start/ Retrigger possible/ Continuous update possible | 0.0, ±0.0001 to ±2500000000.0  | 0.0           | The command velocity is set.<br>When the velocity is negative, the axis moves in the reverse direction.<br>When this setting is omitted, the axis does not operate, but Axis status ( <u>AxisName</u> .Md.AxisStatus) changes to "6: During continuous operation (ContinuousMotion)".<br>For details, refer to the following.<br>Page 1723 Velocity (Velocity) |
| Acceleration     | Acceleration      | LREAL     | At start/ Retrigger possible/ Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The acceleration is set.<br>For details, refer to the following.<br>Page 1723 Acceleration (Acceleration)                                                                                                                                                                                                                                                      |

| Input variable | Name                   | Data type                   | Input                                                                   | Valid range                       | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------|------------------------|-----------------------------|-------------------------------------------------------------------------|-----------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Deceleration   | Deceleration           | LREAL                       | At start/<br>Retrigger<br>possible/<br>Continuous<br>update<br>possible | 0.0000, 0.0001 to<br>2147483647.0 | 0.0           | The deceleration is set.<br>For details, refer to the following.<br> Page 1724 Deceleration (Deceleration)                                                                                                                                                                                                                                                                                                    |
| Jerk           | Jerk                   | LREAL                       | At start                                                                | 0.0000, 0.0001 to<br>2147483647.0 | 0.0           | The jerk is set.<br>For details, refer to the following.<br> Page 1724 Jerk (Jerk)                                                                                                                                                                                                                                                                                                                            |
| Direction      | Direction<br>selection | INT<br>(MC_DIRE<br>CTION)   | At start                                                                | 1, 2                              | 0             | The direction is set.<br><ul style="list-style-type: none"> <li>• 1: Positive direction (mcPositiveDirection)</li> <li>• 2: Negative direction (mcNegativeDirection)</li> </ul> * When "2: Negative direction (mcNegativeDirection)" is set and Velocity (Velocity) is negative, the movement direction of the motor will be positive.<br>* If this setting is omitted, Out of Direction Selection Range (error code: 1AA5H) occurs.                                                             |
| BufferMode     | Buffer mode            | INT<br>(MC_BUFF<br>ER_MODE) | At start                                                                | 0 to 5                            | 0             | The buffer mode is set.<br><ul style="list-style-type: none"> <li>• 0: Aborting (mcAborting)</li> <li>• 1: Buffered (mcBuffered)</li> <li>• 2: BlendingLow (mcBlendingLow)</li> <li>• 3: BlendingPrevious (mcBlendingPrevious)</li> <li>• 4: BlendingNext (mcBlendingNext)</li> <li>• 5: BlendingHigh (mcBlendingHigh)</li> </ul> For details, refer to the following.<br> Page 1724 Buffer mode (BufferMode) |
| Options        | Options                | DWORD(H<br>EX)              | At start                                                                | 00000000H to<br>00000001H         | 00000000H     | The function options for MCv_SpeedControl (Speed Control (Including Position Loop)) are set in the specified bit position.<br>For details, refer to the following.<br> Page 1725 Options (Options)                                                                                                                                                                                                          |

## ■Output variables

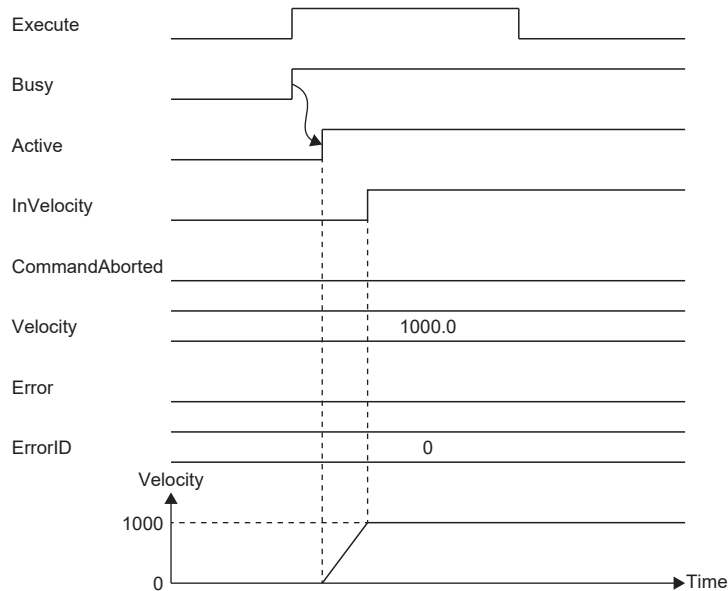
| Output variable | Name                          | Data type  | Default value | Description                                                                                                                                                                                                                                                                        |
|-----------------|-------------------------------|------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InVelocity      | Target<br>velocity<br>reached | BOOL       | FALSE         | This variable becomes TRUE when the command velocity reaches the target velocity.<br>When the target velocity has been changed due to change at Continuous update (ContinuousUpdate) TRUE, this variable remains FALSE until the velocity reaches the post-change target velocity. |
| Busy            | Executing                     | BOOL       | FALSE         | This variable becomes TRUE when MCv_SpeedControl (Speed Control (Including Position Loop)) is executed.                                                                                                                                                                            |
| Active          | Controlling                   | BOOL       | FALSE         | This variable becomes TRUE while MCv_SpeedControl (Speed Control (Including Position Loop)) is controlling the axis.                                                                                                                                                               |
| CommandAborted  | Abortion of<br>execution      | BOOL       | FALSE         | This variable becomes TRUE when execution of MCv_SpeedControl (Speed Control (Including Position Loop)) is aborted.<br>The variable becomes FALSE when Execution command (Execute) becomes FALSE.                                                                                  |
| Error           | Error                         | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                   |
| ErrorID         | Error code                    | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                    |

## Processing details

This FB sets the drive unit control mode to csp (cyclic synchronous position mode) and executes the speed control for the specified axis using the specified velocity. To stop the axis, use MC\_Stop (Forced Stop) or start another motion FB. To perform the speed control with the control mode of the drive unit set to csv (cyclic synchronous velocity mode), use MC\_MoveVelocity (Speed Control).

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

☞ Page 1432 Basic operation of Execution command (Execute) type motion control FBs

### ■Velocity (Velocity)

Sets the command velocity used in MCv\_SpeedControl (Speed Control (Including Position Loop)).

#### Setting range

0.0,  $\pm 0.0001$  to  $\pm 25000000000.0^{*1*2}$

- \*1 To perform floating-point operation, the lower limit value of the command velocity is limited by the following restrictions. If the velocity converted from the command velocity to operation cycle is less than 0.00001, Out of Operation Cycle Converted Velocity Range (error code: 1B16H) (when changing the velocity, Out of Operation Cycle Converted Velocity Range Warning (event code: 00D2FH)) occurs. To improve the precision of floating-point operation, change Position command unit ([AxisName.Pr.Unit\\_Position](#)) and Speed command unit ([AxisName.Pr.Unit\\_Velocity](#)) and perform settings so that the velocity converted into the operation cycle is not less than "0.00001".
- \*2 When a Motion control FB with a commanded velocity of "0.0" performs a multiple start, the commanded velocity of the previous Motion control FB is used.

### ■Acceleration (Acceleration)

Sets the acceleration used in MCv\_SpeedControl (Speed Control (Including Position Loop)).

The setting range differs depending on the setting for Acceleration/deceleration method setting (Options (Options): Bit 0 to 2).

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                   |
|--------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | $0.0000^{*1}$ , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | $0.000000^{*1}$ , positive numbers from 0.000001 to 8400.0[s]                   |

- \*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 ([AxisName.Pr.AccelerationZeroBehavior](#)). When changing the acceleration or deceleration, the changes are not accepted.

## ■Deceleration (Deceleration)

Sets the deceleration used in MCv\_SpeedControl (Speed Control (Including Position Loop)).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Deceleration (Deceleration) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                               |

<sup>\*1</sup> The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Jerk (Jerk)

Sets the jerk used in MCv\_SpeedControl (Speed Control (Including Position Loop)).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Jerk (Jerk) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                           |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000, positive numbers from 0.0001 to 2147483647.0[U/s <sup>3</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                |

## ■Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following buffer modes are settable in MCv\_SpeedControl (Speed Control (Including Position Loop)).

| Setting value                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting)                 | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                                                                                                                                                                                                                          |
| 1: Buffered (mcBuffered)                 | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB.                                                                                                                                                                                                    |
| 2: BlendingLow (mcBlendingLow)           | Buffers the next FB on the under-control FB. <sup>*1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the lower target velocity between the under-control FB and the buffering FB is used as the switching speed.  |
| 3: BlendingPrevious (mcBlendingPrevious) | Buffers the next FB on the under-control FB. <sup>*1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the under-control FB is used as the switching speed.                                  |
| 4: BlendingNext (mcBlendingNext)         | Buffers the next FB on the under-control FB. <sup>*1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the buffering FB is used as the switching speed.                                      |
| 5: BlendingHigh (mcBlendingHigh)         | Buffers the next FB on the under-control FB. <sup>*1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the higher target velocity between the under-control FB and the buffering FB is used as the switching speed. |

<sup>\*1</sup> Stops are not performed between the under-control FB and the buffering FB.

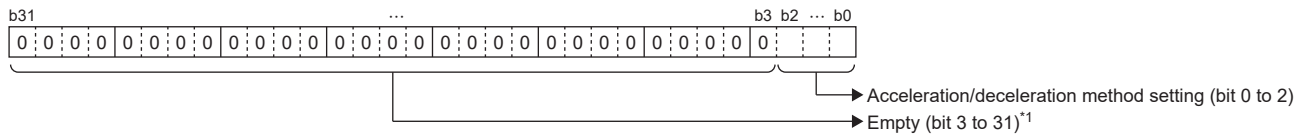


For details on multiple start (buffer mode), refer to the following.

User's manual for the controller used

## ■Options (Options)

The function options for MCv\_SpeedControl (Speed Control (Including Position Loop)) are set in the specified bit position. The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

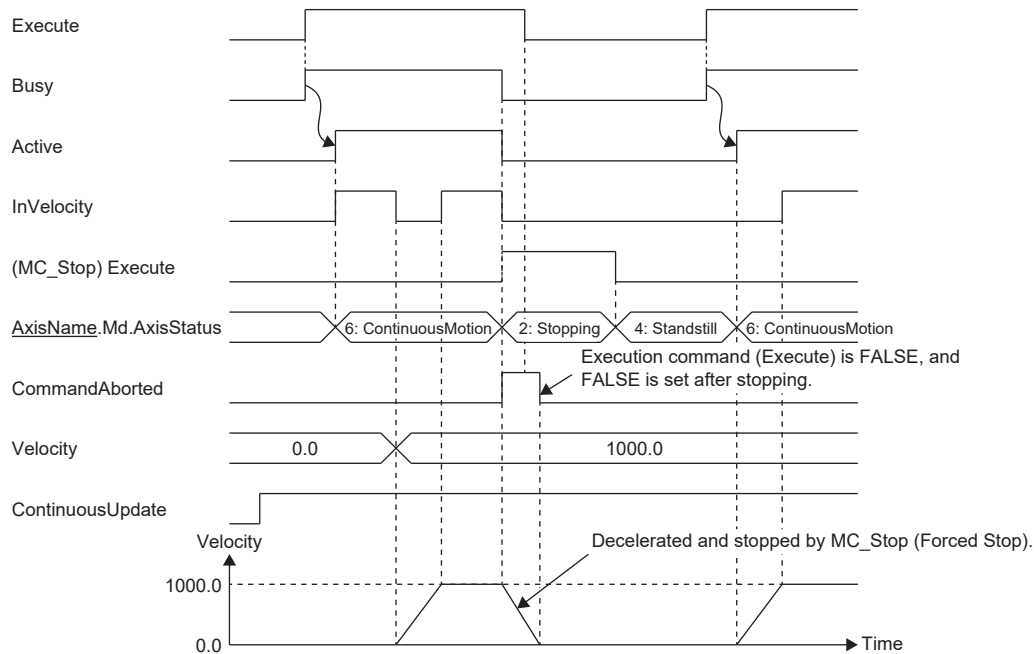
| Bit    | Name                                            | Description                                                                                                                                                                                                                                             |
|--------|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 2 | Acceleration/<br>deceleration method<br>setting | Sets the acceleration/deceleration method used to perform control. <ul style="list-style-type: none"> <li>0: Acceleration/deceleration specification method (mcAccDec)</li> <li>1: Acceleration/deceleration time-fixed method (mcFixedTime)</li> </ul> |

### • Acceleration/deceleration method setting (Bit 0 to 2)

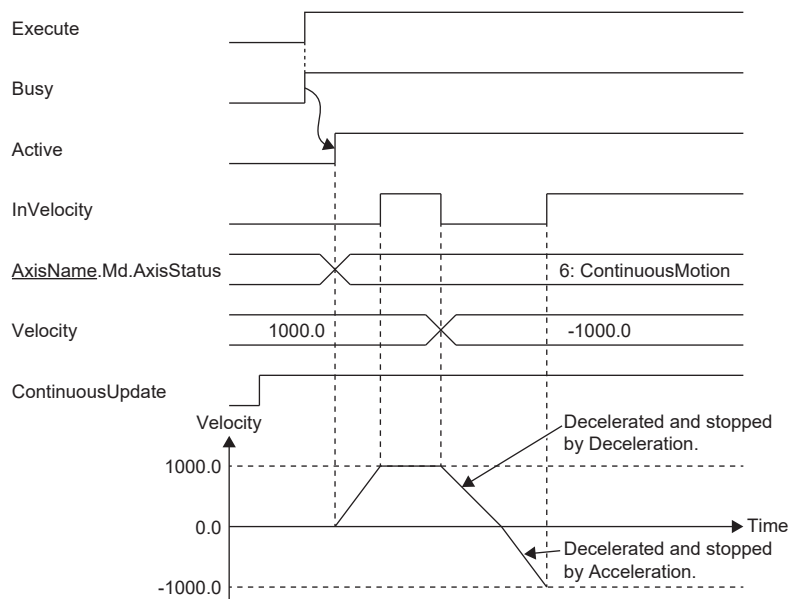
| Setting value                                                   | Description                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration<br>specification method (mcAccDec) | An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) set in MCv_SpeedControl (Speed Control (Including Position Loop)).                                                                                                                         |
| 1: Acceleration/deceleration time-fixed<br>method (mcFixedTime) | An acceleration/deceleration method using the acceleration/deceleration time specified in MCv_SpeedControl (Speed Control (Including Position Loop)) regardless of the velocity.<br>The acceleration/deceleration time does not use Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). |

## ■ Operation overview

- The operation at start and when a stop cause occurs is shown below.



- If the sign of Velocity (Velocity) is reversed and the operation direction is changed when Continuous update (ContinuousUpdate) is TRUE, the axis accelerates toward the target velocity once after the deceleration stop.



## ■ Necessary object data

When using MCv\_SpeedControl (Speed Control (Including Position Loop)) for a single axis, set the following object data for the axis.

- Target position (607AH)

If the object data is not set, Necessary Slave Object Unset (error code: 1AF7H) occurs and the axis will not start.

For details on object data settings, refer to the following.

📖 User's manual for the controller used



## Program example

The following is a program example. The speed control command (bSpeedControl) is set to TRUE, the mode is switched to speed control including position loop, and speed control including position loop is performed for Axis 1 (Axis0001).

- Setting

| Item         | Setting value |
|--------------|---------------|
| Velocity     | 100000.0      |
| Acceleration | 50000.0       |
| Deceleration | 50000.0       |
| Jerk         | 0.0           |

### ■Axis

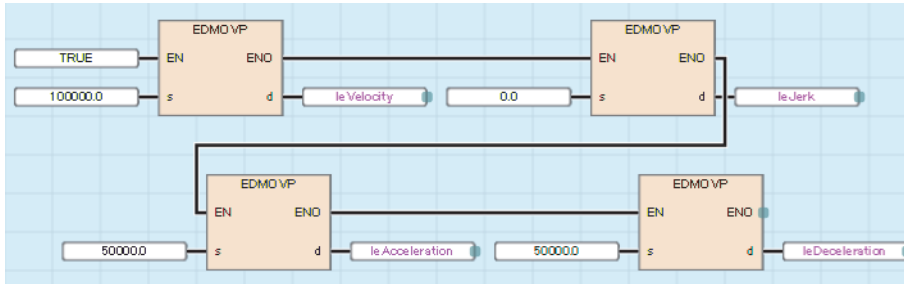
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |

### ■Labels used

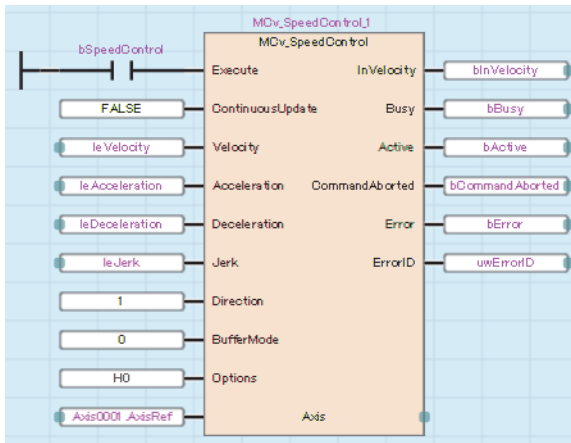
| Label name         | Data type                           | Comment                 |
|--------------------|-------------------------------------|-------------------------|
| MCv_SpeedControl_1 | MCv_SpeedControl                    | Speed Control FB        |
| bSpeedControl      | Bit                                 | Speed control command   |
| leVelocity         | Double-precision real number        | Command velocity        |
| leAcceleration     | Double-precision real number        | Acceleration            |
| leDeceleration     | Double-precision real number        | Deceleration            |
| leJerk             | Double-precision real number        | Jerk                    |
| bInVelocity        | Bit                                 | Target velocity reached |
| bBusy              | Bit                                 | Executing               |
| bActive            | Bit                                 | Controlling             |
| bCommandAborted    | Bit                                 | Abortion of execution   |
| bError             | Bit                                 | Error                   |
| uwErrorID          | Word [unsigned]/bit string [16-bit] | Error code              |

## ■ FBD/LD program

- Data settings for speed control



- Speed Control (Including Position Loop)



## ■ST program

```
//-----Data settings for speed control-----
leVelocity:= 100000.0;
leAcceleration:= 50000.0;
leDeceleration:= 50000.0;
leJerk:= 0.0;

//-----Speed Control (Including Position Loop)-----
MCv_SpeedControl_1(
  Axis:= Axis0001.AxisRef ,
  Execute:= bSpeedControl ,
  ContinuousUpdate:= FALSE ,
  Velocity:= leVelocity ,
  Acceleration:= leAcceleration ,
  Deceleration:= leDeceleration ,
  Jerk:= leJerk ,
  Direction:= MC_DIRECTION__mcPositiveDirection ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= H00000000 ,
  InVelocity=> bInVelocity ,
  Busy=> bBusy ,
  Active=> bActive ,
  CommandAborted=> bCommandAborted ,
  Error=> bError ,
  ErrorID=> uwErrorID
);
```

# 46.10 Absolute Value Linear Interpolation Control

## MCv\_MoveLinearInterpolateAbsolute

This FB specifies the target position of the absolute position of the set axes group and performs positioning by linear interpolation control.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MCv_MoveLinearInterpolateAbsolute(   AxesGroup:= ?AXES_GROUP_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   LinearAxes:= ?INT(0..15)? ,   Position:= ?LREAL(0..15)? ,   Velocity:= ?LREAL? ,   Acceleration:= ?LREAL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   VelocityMode:= ?INT? ,   Direction:= ?INT(0..15)? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name                   | Data type      | Input    | Valid range | Default value         | Description                                                                                                                                                                                                          |
|--------------|------------------------|----------------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxesGroup    | Axes group information | AXES_GROUP_REF | At start | —           | Omission not possible | An axes group is set.<br>For the variable <code>(AxesGroupName.AxesGroupRef.)</code> used, refer to the following.<br><a href="#">Page 1468</a><br><code>AxesGroupName.AxesGroupRef.</code> (Axes group information) |

#### Input variable

| Input variable   | Name              | Data type | Input    | Valid range | Default value | Description                                                                                                                                                                                                                                                                                                                                          |
|------------------|-------------------|-----------|----------|-------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute          | Start             | BOOL      | At start | TRUE, FALSE | FALSE         | When this variable is set to TRUE, MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control) is executed.                                                                                                                                                                                                                      |
| ContinuousUpdate | Continuous update | BOOL      | At start | TRUE, FALSE | FALSE         | Whether to enable or disable continuous change of Velocity (Velocity), Acceleration (Acceleration), and Deceleration (Deceleration) is set.<br>Continuous update re-imports input variables to the instance in execution without aborting the operation.<br><ul style="list-style-type: none"> <li>FALSE: Disabled</li> <li>TRUE: Enabled</li> </ul> |

| Input variable | Name                      | Data type                       | Input                                                          | Valid range                     | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------|---------------------------|---------------------------------|----------------------------------------------------------------|---------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LinearAxes     | Linear interpolation axis | INT[0..15]                      | At start                                                       | 1 to 16                         | 0             | The axes to be used in linear interpolation control are set from the configuration axes. Specify the index No. (1 to 16) of the configuration axes in the array.<br>* When Velocity mode (VelocityMode) is set to "2: Reference axis speed (ReferenceAxisSpeed)", the first element of the array is regarded as the reference axis.<br>For details, refer to the following.<br> Page 1733 Linear interpolation axis (LinearAxes)                                            |
| Position       | Target position           | LREAL[0..15]                    | At start                                                       | -10000000000.0 to 10000000000.0 | 0.0           | The target position for linear interpolation is set.<br>The value is set as one-dimensional array data. The data is treated as the absolute position for configuration axes 1 to 16.<br>For details, refer to the following.<br> Page 1734 Target position (Position)                                                                                                                                                                                                       |
| Velocity       | Velocity                  | LREAL                           | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0, 0.0001 to 2500000000.0     | 0.0           | The speed command value is set.<br>For details, refer to the following.<br> Page 1734 Velocity (Velocity)                                                                                                                                                                                                                                                                                                                                                                   |
| Acceleration   | Acceleration              | LREAL                           | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0  | 0.0           | The acceleration is set.<br>For details, refer to the following.<br> Page 1735 Acceleration (Acceleration)                                                                                                                                                                                                                                                                                                                                                                  |
| Deceleration   | Deceleration              | LREAL                           | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0  | 0.0           | The deceleration is set.<br>For details, refer to the following.<br> Page 1735 Deceleration (Deceleration)                                                                                                                                                                                                                                                                                                                                                                |
| Jerk           | Jerk                      | LREAL                           | At start                                                       | 0.0000, 0.0001 to 2147483647.0  | 0.0           | The jerk is set.<br>For details, refer to the following.<br> Page 1735 Jerk (Jerk)                                                                                                                                                                                                                                                                                                                                                                                        |
| VelocityMode   | Speed mode                | INT (MC_INTERPOLATE_SPEED_MODE) | At start                                                       | 0 to 2                          | 0             | The speed mode for interpolation control is set.<br>• 0: Vector speed (VectorSpeed)<br>• 1: Long axis speed (LongAxisSpeed)<br>• 2: Reference axis speed (ReferenceAxisSpeed)<br>For details, refer to the following.<br> Page 1736 Velocity mode (VelocityMode)                                                                                                                                                                                                          |
| Direction      | Direction selection       | INT (MC_DIRECTION[0..15])       | At start                                                       | 1 to 3                          | 0             | The direction is set.<br>The value is set as one-dimensional array data. The data is treated as the direction for configuration axes 1 to 16.<br>• 1: Positive direction (mcPositiveDirection)<br>• 2: Negative direction (mcNegativeDirection)<br>• 3: Shortest path (mcShortestWay)<br>* If this setting is omitted, Out of Direction Selection Range (error code: 1AA5H) occurs.<br>For details, refer to the following.<br> Page 1738 Direction selection (Direction) |

| Input variable | Name        | Data type               | Input    | Valid range            | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------|-------------|-------------------------|----------|------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BufferMode     | Buffer mode | INT<br>(MC_BUFFER_MODE) | At start | 0 to 5                 | 0             | The buffer mode is set.<br><ul style="list-style-type: none"> <li>• 0: Aborting (mcAborting)</li> <li>• 1: Buffered (mcBuffered)</li> <li>• 2: BlendingLow (mcBlendingLow)</li> <li>• 3: BlendingPrevious (mcBlendingPrevious)</li> <li>• 4: BlendingNext (mcBlendingNext)</li> <li>• 5: BlendingHigh (mcBlendingHigh)</li> </ul> For details, refer to the following.<br> Page 1738 Buffer mode (BufferMode) |
| Options        | Options     | DWORD(HEX)              | At start | 00000000H to 00010001H | 00000000H     | The function options for MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control) are set in the specified bit position.<br>For details, refer to the following.<br> Page 1739 Options (Options)                                                                                                                                                                                       |

## ■Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------|-----------------------|------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Completion            | BOOL       | FALSE         | This variable becomes TRUE when the control is completed.<br>The value differs depending on the status of Start (Execute) at operation completion.<br>■When Start (Execute) is TRUE<br>This variable remains TRUE until Start (Execute) is set to FALSE.<br>■When Start (Execute) is FALSE<br>This variable becomes TRUE only for one cycle.                                                                           |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control) is executed.                                                                                                                                                                                                                                                                                           |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control) is controlling the axis.<br>When multiple MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control) FBs are executed for the same axes group, Controlling (Active) of only one MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control) FB becomes TRUE. |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control) is aborted because of an error or multiple start.                                                                                                                                                                                                                                         |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                                                                                       |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                                                                                                                                                        |

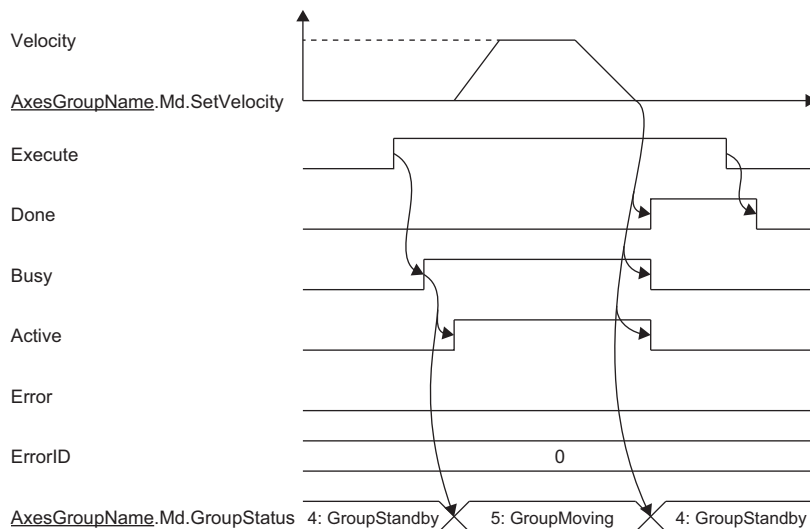
## Processing details

- This FB specifies an axes group and performs interpolation control so that the path from the start point (move start point) to the end point becomes a straight line. In linear interpolation control, interpolation control using a maximum of 4 axes is performed.
- In MCv\_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control), specify the target position used for the absolute position and perform absolute value linear interpolation control.
- For the operation of Absolute Value Linear Interpolation Control for axes 1 to 3, refer to "Linear Interpolation Control" in the following.

 User's manual for the controller used

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

### ■Linear interpolation axis (LinearAxes)

In linear interpolation control, linear interpolation is performed using arbitrary axes from the configuration axes set to the axes group.

Set configuration axes to perform linear interpolation by Linear interpolation axis (LinearAxes) from the configuration axes of the axes group. Linear interpolation axis (LinearAxes) has 16 array elements. For the arrays, first set only the index Nos. (1 to 16: configuration axis 1 to 16) of configuration axes to be used for interpolation control to the front, then set the rest of the arrays to "0". Arrays set to "0" can be omitted.

- The setting number of the linear interpolation axes must be set to the maximum number of the interpolation axes for interpolation control (4 axes) or less.
- The number of configuration axes to be used for interpolation control must be the number of axes registered to the configuration axes or less.
- When Velocity mode (VelocityMode) is "2: Reference axis speed (ReferenceAxisSpeed)", the configuration axis of the first element in Linear interpolation axis (LinearAxes) becomes the reference axis.
- If the following is specified, Linear Interpolation Axis Setting Incorrect (error code: 1B08H) occurs and the axis will not start.
  - When specifying a configuration axis where an axis is not set
  - When the first element of Linear interpolation axis (LinearAxes) is "0"
  - When specifying the same index No. to Linear interpolation axis (LinearAxes) in duplicate
  - When the number of axes set in Linear interpolation axis (LinearAxes) exceeds the maximum number of interpolation axes

**Ex.**

When configuration axis 2, 3, and 4 are set to the linear interpolation axis

```
LinearAxes[0]:= 2;
LinearAxes[1]:= 3;
LinearAxes[2]:= 4;
LinearAxes[3]:= 0; *1
:
LinearAxes[15]:= 0; *1
```

\*1 "LinearAxes[3]:= 0; to LinearAxes[15]:= 0;" can be omitted.

**■Target position (Position)**

Sets the target position for linear interpolation.

Target position (Position) has 16 array elements.

- The valid range differs depending on whether the software stroke limit is valid/invalid, Direction selection (Direction), and the setting for Target position specification exceeding the ring counter (Options (Options): Bit 16). For details, refer to the following.

 Page 1672 Target position (Position)

- Position[0..15] indicates the target position of configuration axis 1 to 16. Set the position in relation to the configuration axes set in Linear interpolation axis (LinearAxes).
- Target position (Position) of configuration axes not set to the linear interpolation axes is ignored.
- Target position (Position) of axes after all configuration axes set to the linear interpolation axes can be omitted.

**Ex.**

When setting configuration axis 2, 3, 4 to the linear interpolation axes, and setting the target positions of configuration axis 2, 3, and 4 to 2000.0, 3000.0, and 4000.0

```
LinearAxes[0]:= 2;
LinearAxes[1]:= 3;
LinearAxes[2]:= 4;
LinearAxes[3]:= 0; *1
:
LinearAxes[15]:= 0; *1
Position[0]:= 0.0;
Position[1]:= 2000.0;
Position[2]:= 3000.0;
Position[3]:= 4000.0;
Position[4]:= 0.0; *1
:
Position[15]:= 0.0; *1
```

\*1 "LinearAxes[3]:= 0; to LinearAxes[15]:= 0;" and "Position[4]:= 0.0; to Position[15]:= 0.0;" can be omitted.

**■Velocity (Velocity)**

Sets the maximum speed of the path used in MCv\_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control).

**Setting range**

0.0, 0.0001 to 25000000000.0 \*1\*2

- \*1 To perform floating-point operation, the lower limit value of the command velocity is limited by the following restrictions.  
If the velocity converted from the command velocity to operation cycle is less than 0.00001, Out of Operation Cycle Converted Velocity Range (error code: 1B16H) (when changing the velocity, Out of Operation Cycle Converted Velocity Range Warning (event code: 00D2FH)) occurs. To improve the precision of floating-point operation, change Position command unit (AxisName.Pr.Unit\_Position) and Speed command unit (AxisName.Pr.Unit\_Velocity) and perform settings so that the velocity converted into the operation cycle is not less than "0.00001".
- \*2 When a Motion control FB with a commanded velocity of "0.0" performs a multiple start, the commanded velocity of the previous Motion control FB is used.



### ■Acceleration (Acceleration)

Sets the acceleration used in MCv\_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control).

The setting range differs depending on the setting for Acceleration/deceleration method setting (Options (Options): Bit 0 to 2).

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | 0.000000 <sup>*1</sup> , positive numbers from 0.000001 to 8400.0[s]                   |

\*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

### ■Deceleration (Deceleration)

Sets the deceleration used in MCv\_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Deceleration (Deceleration) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                               |

\*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

### ■Jerk (Jerk)

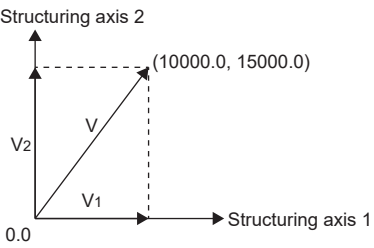
Sets the jerk used in MCv\_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Jerk (Jerk) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                           |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000, positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                |

## ■Velocity mode (VelocityMode)

Specifies the velocity mode used in linear interpolation control. When specifying "2: Reference axis speed (ReferenceAxisSpeed)" in Velocity mode (VelocityMode), the reference axis becomes the configuration axis specified to the first element of Linear interpolation axis (LinearAxes).

| Setting value                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Vector speed (VectorSpeed)      | <p>Sets Velocity (Velocity) as the vector speed.</p> <p>The positioning speed (<math>V_n</math>) of each axis is calculated from the movement amount (<math>D_n</math>) of each axis by the Motion system based on the positioning speed (<math>V</math>) of the set control target.</p> <p>&lt;Example&gt;</p> <p>When using 2-axis linear interpolation control</p>  <ul style="list-style-type: none"> <li>• Configuration axis 1 movement amount (<math>D_1</math>): 10000.0 [pulse]</li> <li>• Configuration axis 2 movement amount (<math>D_2</math>): 15000.0 [pulse]</li> <li>• Axes group speed unit: [s]</li> <li>• Vector speed (<math>V</math>): 7000.0 [pulse/s]</li> </ul> <p>For the above conditions, the positioning speed of each axis is calculated by the Motion system with the following calculation formulas.</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 positioning speed: <math>V_1 = V \times D_1 / \sqrt{D_1^2 + D_2^2}</math></li> <li>• Configuration axis 2 positioning speed: <math>V_2 = V \times D_2 / \sqrt{D_1^2 + D_2^2}</math></li> </ul> <p>■Point</p> <ul style="list-style-type: none"> <li>• For the vector speed specification, the set speed limit value is valid as the vector speed for Velocity (Velocity).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 1: Long axis speed (LongAxisSpeed) | <p>Sets Velocity (Velocity) as the velocity of the long axis.</p> <p>The control is carried out based on the positioning speed (the long axis velocity: <math>V</math>) of the interpolation axis whose movement amount is the largest in the specified positions set in each interpolation axis.</p> <p>The positioning speed (<math>V_n</math>) of the other interpolation axes is calculated by the Motion system from the movement amount (<math>D_n</math>) of each interpolation axis.</p> <p>&lt;Example&gt;</p> <p>When using 4-axis linear interpolation control</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 movement amount (<math>D_1</math>): 10000.0 [pulse]</li> <li>• Configuration axis 2 movement amount (<math>D_2</math>): 15000.0 [pulse]</li> <li>• Configuration axis 3 movement amount (<math>D_3</math>): 5000.0 [pulse]</li> <li>• Configuration axis 4 movement amount (<math>D_4</math>): 20000.0 [pulse]</li> <li>• Configuration axis 4 speed unit: [s]</li> <li>• Long axis speed (<math>V</math>): 7000.0 [pulse/s]</li> </ul> <p>In the above case, the long axis is configuration axis 4 whose movement amount is the largest, and the control is carried out based on the long axis velocity of configuration axis 4.</p> <p>The positioning speed of the other configuration axes is calculated by the Motion system with the following calculation formulas.</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 positioning speed: <math>V_1 = D_1 / D_4 \times V</math></li> <li>• Configuration axis 2 positioning speed: <math>V_2 = D_2 / D_4 \times V</math></li> <li>• Configuration axis 3 positioning speed: <math>V_3 = D_3 / D_4 \times V</math></li> </ul> <p>■Point</p> <ul style="list-style-type: none"> <li>• For the long axis speed specification, the set speed limit value is valid as the long axis velocity for Velocity (Velocity).</li> <li>• Note that the vector speed may be larger than the speed limit value when specifying Long axis speed. When a value is set as shown below in the 2-axis linear interpolation, the vector velocity exceeds the velocity limit value.</li> </ul> <p>&lt;Example&gt;</p> <p>When the setting items and the setting values are as follows.</p> <ul style="list-style-type: none"> <li>• Linear interpolation axes: Configuration axis 1, Configuration axis 2</li> <li>• Configuration axis 1 movement amount: 100 [pulses]</li> <li>• Configuration axis 2 movement amount: 200 [pulses]</li> <li>• Long axis velocity: 50 [pulses/s]</li> <li>• Velocity limit value of configuration axis 2: 55 [pulses/s]</li> </ul> <p>In the above case, the reference axis is configuration axis 2 whose movement amount is the largest, and the control is carried out with the velocity limit value set for configuration axis 2. The positioning speed and the vector velocity of each axis are shown below.</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 positioning speed: <math>100/200 \times 50 = 25</math> [pulses/s]</li> <li>• Configuration axis 2 positioning speed: 50 [pulses/s]</li> <li>• Vector velocity: <math>\sqrt{(25^2 + 50^2)} = 55.9</math> [pulses/s]</li> </ul> <p>The vector velocity becomes a value that exceeds the velocity limit value "55" of configuration axis 2.</p> |

| Setting value                                   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2: Reference axis speed<br>(ReferenceAxisSpeed) | <p>Sets Velocity (Velocity) as the velocity of the reference axis.</p> <p>The Motion system calculates the positioning speed (Vn) of the other interpolation axes from the movement amount (Dn) of each interpolation axis and performs control based on the positioning speed of the set reference axis (the reference axis velocity: V).</p> <p>If "0.0" is set for the movement amount of the configuration axis specified as the reference axis, Reference Axis Movement Amount 0 (error code: 1AFAH) occurs.</p> <p>&lt;Example&gt;</p> <p>When using 4-axis linear interpolation control</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 movement amount (D<sub>1</sub>): 10000.0 [pulse]</li> <li>• Configuration axis 2 movement amount (D<sub>2</sub>): 15000.0 [pulse]</li> <li>• Configuration axis 3 movement amount (D<sub>3</sub>): 5000.0 [pulse]</li> <li>• Configuration axis 4 movement amount (D<sub>4</sub>): 20000.0 [pulse]</li> <li>• Reference axis velocity (V): 7000.0 [pulse/s]</li> </ul> <p>In the above case, the long axis is configuration axis 4 whose movement amount is the largest, and the control is carried out based on the positioning speed set for configuration axis 4.</p> <p>The positioning speed of the other configuration axes is calculated by the Motion system with the following calculation formulas.</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 positioning speed: <math>V_1 = D_1 / D_4 \times V</math></li> <li>• Configuration axis 2 positioning speed: <math>V_2 = D_2 / D_4 \times V</math></li> <li>• Configuration axis 3 positioning speed: <math>V_3 = D_3 / D_4 \times V</math></li> </ul> <p>■Point</p> <ul style="list-style-type: none"> <li>• For the reference axis speed specification, the set speed limit value is valid as the reference axis velocity for Velocity (Velocity).</li> <li>• Note that the positioning speed may be larger than the set reference axis velocity for axes with a movement amount larger than the reference axis. When a value is set as shown below in the 2-axis linear interpolation, the positioning speed and the vector velocity of configuration axis 2 exceed the velocity limit value.</li> </ul> <p>&lt;Example&gt;</p> <p>When the setting items and the setting values are as follows.</p> <ul style="list-style-type: none"> <li>• Linear interpolation axes: Configuration axis 1, Configuration axis 2</li> <li>• Configuration axis 1 movement amount: 100 [pulses]</li> <li>• Configuration axis 2 movement amount: 200 [pulses]</li> <li>• Reference axis velocity: 50 [pulses/s]</li> <li>• Velocity limit value of configuration axis 1: 55 [pulses/s]</li> </ul> <p>In the above case, the reference axis is configuration axis 1, and control is carried out with the velocity limit value set for configuration axis 1. The positioning speed and the vector velocity of each axis are shown below.</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 positioning speed: 50 [pulses/s]</li> <li>• Configuration axis 2 positioning speed: <math>200/100 \times 50 = 100</math> [pulses/s]</li> <li>• Vector velocity: <math>\sqrt{(50^2 + 100^2)} = 111.8</math> [pulses/s]</li> </ul> <p>The positioning speed and the vector velocity of configuration axis 2 become a value that exceeds the velocity limit value "55" of configuration axis 1.</p> |

### Restriction

- When "0: Vector speed (VectorSpeed)" is set in Velocity mode (VelocityMode) and the movement value of each axis exceeds "4,294,967,296.0 (=2<sup>32</sup>)", Out of Linear Movement Amount Range (error code: 1B10H) will occur and the axis will not start.
- When "0: Aborting (mcAborting)" is set in Buffer mode (BufferMode) and MCv\_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control) is executed by multiple start, specify "0: Vector speed (VectorSpeed)" in Velocity mode (VelocityMode). If a value other than "0: Vector speed (VectorSpeed)" is set, Out of Speed Mode Range (error code: 1AC9H) occurs.

## ■Direction selection (Direction)

Specifies the direction used to move from the current position to the target position by selecting positive direction, negative direction, or shortest way. Direction selection (Direction) has 16 array elements.

- Direction[0..15] indicates the direction selection of configuration axis 1 to 16. Set the value for the configuration axis set in Linear interpolation axis (LinearAxes).
- The direction selection (Direction) of the configuration axis which is not set as the linear interpolation axis is ignored.
- Direction selection (Direction) of axes after all configuration axes set to the linear interpolation axes can be omitted.
- If a setting value is not set, Out of Direction Selection Range (error code: 1AA5H) occurs and the axis will not start.
- A linear axis where the software stroke limit is valid ignores the setting of Direction selection (Direction). For details on operation of each direction selection, refer to the following.

 Page 1674 Direction selection (Direction)

| Setting value                               | Description                                                                                                           |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| 1: Positive direction (mcPositiveDirection) | Performs positioning in the positive direction (address increasing) from the current position to the target position. |
| 2: Negative direction (mcNegativeDirection) | Performs positioning in the negative direction (address decreasing) from the current position to the target position. |
| 3: Shortest path (mcShortestWay)            | Based on the current position, positioning control is performed in the direction closest to the target position.      |

## ■Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following buffer modes are settable in MCv\_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control).

| Setting value                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting)                 | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                                                                                                                                                                                                              |
| 1: Buffered (mcBuffered)                 | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB.                                                                                                                                                                                        |
| 2: BlendingLow (mcBlendingLow)           | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the lower target velocity between the under-control FB and the buffering FB is used as the switching speed.  |
| 3: BlendingPrevious (mcBlendingPrevious) | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the under-control FB is used as the switching speed.                                  |
| 4: BlendingNext (mcBlendingNext)         | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the buffering FB is used as the switching speed.                                      |
| 5: BlendingHigh (mcBlendingHigh)         | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the higher target velocity between the under-control FB and the buffering FB is used as the switching speed. |

\*1 Stops are not performed between the under-control FB and the buffering FB.



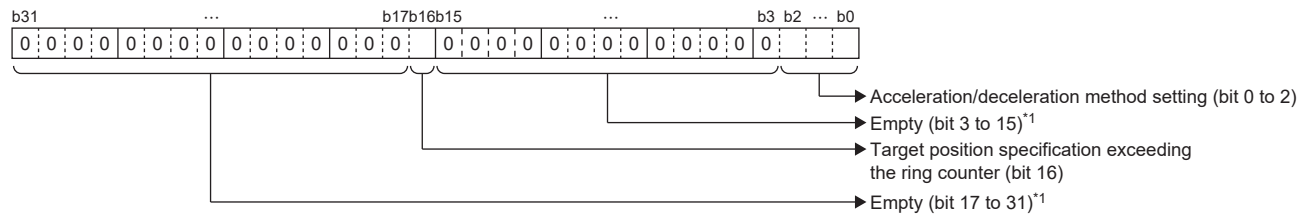
For details on multiple start (buffer mode), refer to the following.

 User's manual for the controller used

## Options (Options)

The function options for MCv\_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit    | Name                                                           | Description                                                                                                                                                                                            |
|--------|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 2 | Acceleration/<br>deceleration method<br>setting                | Sets the acceleration/deceleration method used to perform control.<br>• 0: Acceleration/deceleration specification method (mcAccDec)<br>• 1: Acceleration/deceleration time-fixed method (mcFixedTime) |
| 16     | Target position<br>specification exceeding<br>the ring counter | Sets whether to allow a target position that exceeds the ring counter upper limit value or lower limit value when the software stroke limit is invalid.<br>• 0: Disabled<br>• 1: Enabled               |

• Acceleration/deceleration method setting (Bit 0 to 2)

| Setting value                                                   | Description                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration<br>specification method (mcAccDec) | An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) set in MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control).                                                                                                                      |
| 1: Acceleration/deceleration time-fixed<br>method (mcFixedTime) | An acceleration/deceleration method using the acceleration/deceleration time specified in MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control) regardless of the velocity. The acceleration/deceleration time does not use Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). |

## Necessary object data

When using MCv\_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control), set the following object data for all configuration axes in the specified axes group.

- Target position (607AH)

If there is a structuring axis for which no object data is set, Necessary Object Data Unset (error code: 1AF7H) occurs and the axis will not start.

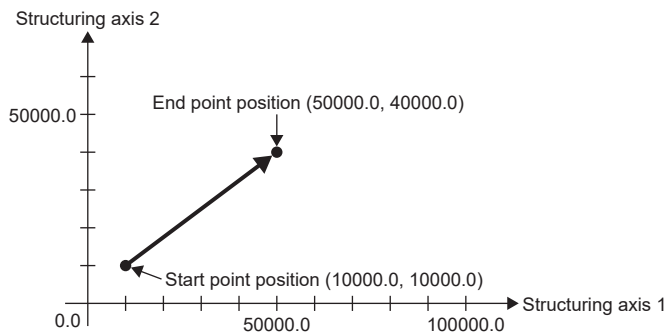
For details on object data settings, refer to the following.

User's manual for the controller used

## Program example

The following is a program example. The linear interpolation control start (bLinearInterpolateCMD) is set to TRUE, and Axes group 1 (AxesGroup001) is enabled. Then, 2-axis linear interpolation absolute positioning control is performed for Axis group 1 (AxesGroup001).

### • Operation



### • Axes group

| Item                  | Setting value |
|-----------------------|---------------|
| Configuration axis[1] | Axis0001      |
| Configuration axis[2] | Axis0002      |

### • Setting

| Item                | Setting value        |                      |
|---------------------|----------------------|----------------------|
|                     | Configuration axis 1 | Configuration axis 2 |
| Target position     | 50000.0              | 40000.0              |
| Velocity            | 50000.0              |                      |
| Acceleration        | 50000.0              |                      |
| Deceleration        | 50000.0              |                      |
| Jerk                | 0.0                  |                      |
| Direction selection | Positive direction   | Positive direction   |

## ■Axes

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |
| 2        | Axis0002   | AXIS_REF  | Axis 2  |

## ■Axes group

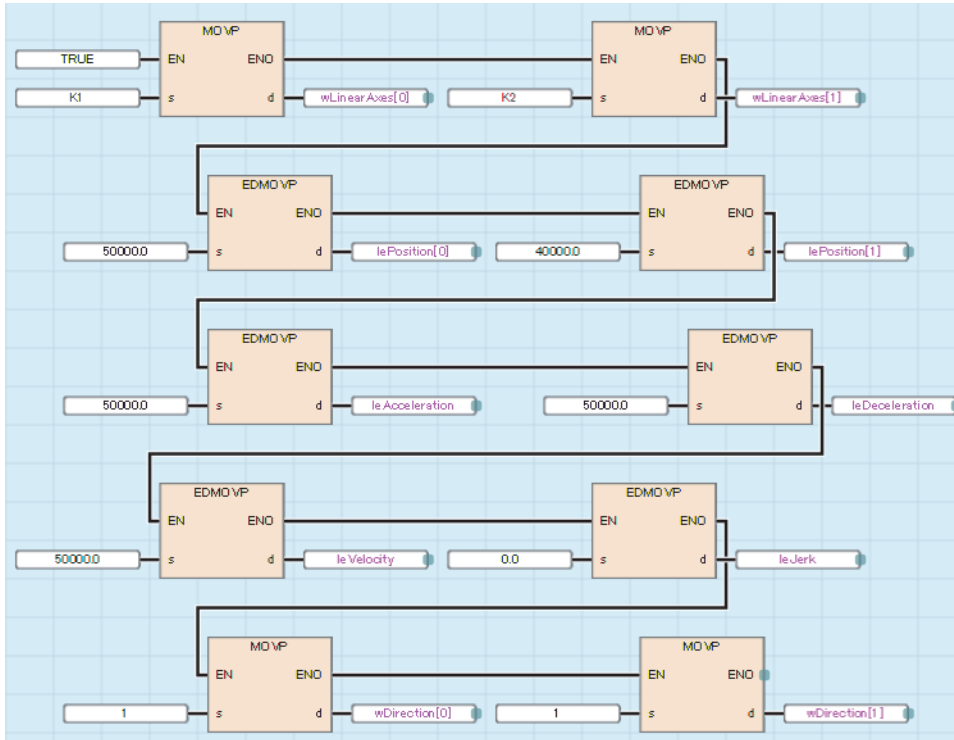
| Axes group No. | Label name   | Data type      | Comment      |
|----------------|--------------|----------------|--------------|
| 1              | AxesGroup001 | AXES_GROUP_REF | Axes group 1 |

## ■Labels used

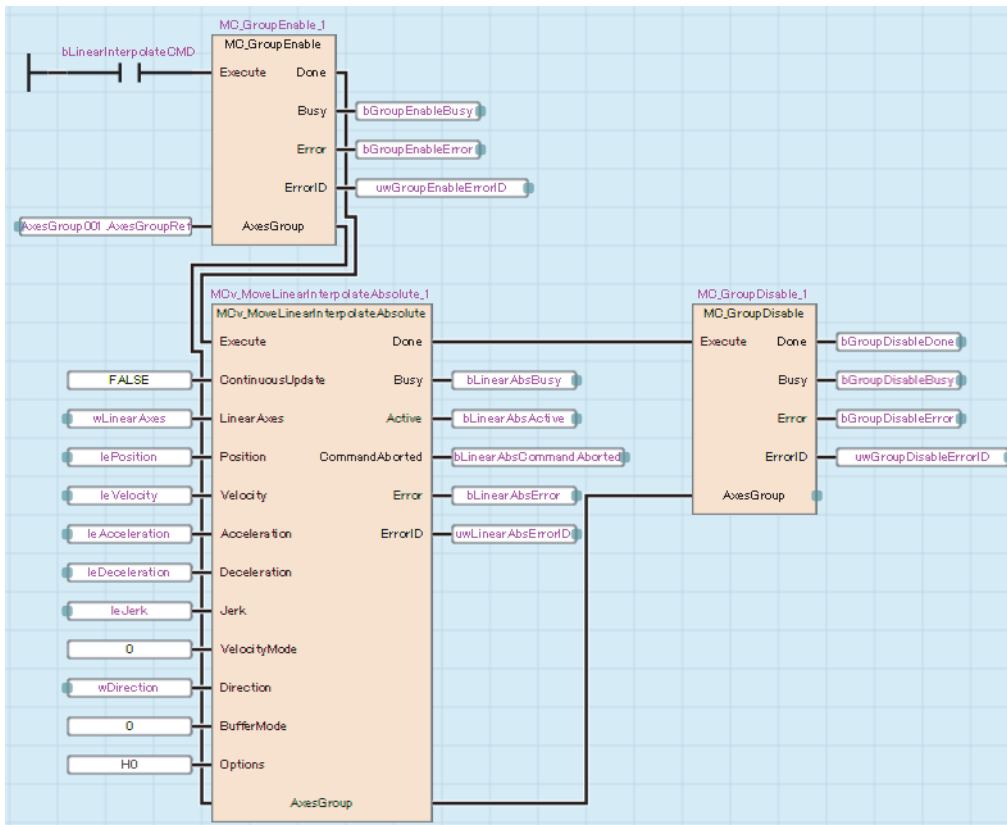
| Label name                          | Data type                           | Comment                                        |
|-------------------------------------|-------------------------------------|------------------------------------------------|
| MCv_MoveLinearInterpolateAbsolute_1 | MCv_MoveLinearInterpolateAbsolute   | Absolute Value Linear Interpolation Control FB |
| wLinearAxes                         | Word [signed](0..15)                | Linear interpolation axis                      |
| lePosition                          | Double-precision real number(0..15) | Target position                                |
| leVelocity                          | Double-precision real number        | Velocity                                       |
| leAcceleration                      | Double-precision real number        | Acceleration                                   |
| leDeceleration                      | Double-precision real number        | Deceleration                                   |
| leJerk                              | Double-precision real number        | Jerk                                           |
| wDirection                          | Word [signed](0..15)                | Direction selection                            |
| bLinearAbsDone                      | Bit                                 | Execution completion                           |
| bLinearAbsBusy                      | Bit                                 | Executing                                      |
| bLinearAbsActive                    | Bit                                 | Controlling                                    |
| bLinearAbsCommandAborted            | Bit                                 | Abortion of execution                          |
| bLinearAbsError                     | Bit                                 | Error                                          |
| uwLinearAbsErrorID                  | Word [unsigned]/bit string [16-bit] | Error code                                     |
| MC_GroupEnable_1                    | MC_GroupEnable                      | Axes Group Enabled FB                          |
| bLinearInterpolateCMD               | Bit                                 | Linear interpolation control start             |
| bGroupEnableDone                    | Bit                                 | Axes Group Enabled Completion                  |
| bGroupEnableBusy                    | Bit                                 | Executing                                      |
| bGroupEnableError                   | Bit                                 | Error                                          |
| uwGroupEnableErrorID                | Word [unsigned]/bit string [16-bit] | Error code                                     |
| MC_GroupDisable_1                   | MC_GroupDisable                     | Axes Group Disabled FB                         |
| bGroupDisableDone                   | Bit                                 | Axes Group Disabled Completion                 |
| bGroupDisableBusy                   | Bit                                 | Executing                                      |
| bGroupDisableError                  | Bit                                 | Error                                          |
| uwGroupDisableErrorID               | Word [unsigned]/bit string [16-bit] | Error code                                     |

## ■FBD/LD program

- Data setting for 2-axis linear interpolation control



- Axes Group Enabled/2-axis linear interpolation control/Axis Group Disabled





## ■ST program

```
//-----Data setting for 2-axis linear interpolation control-----
wLinearAxes[0]:= 1;
wLinearAxes[1]:= 2;
lePosition[0]:= 50000.0;
lePosition[1]:= 40000.0;
leVelocity:= 50000.0;
leAcceleration:= 50000.0;
leDeceleration:= 50000.0;
leJerk:= 0.0;
wDirection[0]:= MC_DIRECTION__mcPositiveDirection;
wDirection[1]:= MC_DIRECTION__mcPositiveDirection;

//-----Axes group enabled-----
MC_GroupEnable_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bLinearInterpolateCMD ,
  Done=> bGroupEnableDone ,
  Busy=> bGroupEnableBusy ,
  Error=> bGroupEnableError ,
  ErrorID=> uwGroupEnableErrorID
);

//-----2-axis linear interpolation control-----
MCv_MoveLinearInterpolateAbsolute_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bGroupEnableDone ,
  ContinuousUpdate:= FALSE ,
  LinearAxes:= wLinearAxes ,
  Position:= lePosition ,
  Velocity:= leVelocity ,
  Acceleration:= leAcceleration ,
  Deceleration:= leDeceleration ,
  Jerk:= leJerk ,
  VelocityMode:= MC_INTERPOLATE_SPEED_MODE__VectorSpeed ,
  Direction:= wDirection ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= H00000000 ,
  Done=> bLinearAbsDone ,
  Busy=> bLinearAbsBusy ,
  Active=> bLinearAbsActive ,
  CommandAborted=> bLinearAbsCommandAborted ,
  Error=> bLinearAbsError ,
  ErrorID=> uwLinearAbsErrorID
);

//-----Axes group disabled-----
MC_GroupDisable_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bLinearAbsDone ,
  Done=> bGroupDisableDone ,
  Busy=> bGroupDisableBusy ,
```

```
Error=> bGroupDisableError ,  
ErrorID=> uwGroupDisableErrorID  
);
```

# 46.11 Relative Value Linear Interpolation Control

46

## MCv\_MoveLinearInterpolateRelative

This FB specifies the movement amount of the relative position of the set axes group and performs positioning by linear interpolation control.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MCv_MoveLinearInterpolateRelative(   AxesGroup:= ?AXES_GROUP_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   LinearAxes:= ?INT(0..15)? ,   Distance:= ?LREAL(0..15)? ,   Velocity:= ?LREAL? ,   Acceleration:= ?LREAL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   VelocityMode:= ?INT? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name                   | Data type      | Input    | Valid range | Default value         | Description                                                                                                                                                                                |
|--------------|------------------------|----------------|----------|-------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxesGroup    | Axes group information | AXES_GROUP_REF | At start | —           | Omission not possible | An axes group is set.<br>For the variable ( <u>AxesGroupName.AxesGroupRef.</u> ) used, refer to the following.<br>Page 1468<br><u>AxesGroupName.AxesGroupRef.</u> (Axes group information) |

#### Input variable

| Input variable   | Name              | Data type | Input    | Valid range | Default value | Description                                                                                                                                                                                                                                                                                      |
|------------------|-------------------|-----------|----------|-------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute          | Start             | BOOL      | At start | TRUE, FALSE | FALSE         | When this variable is set to TRUE, MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control) is executed.                                                                                                                                                                  |
| ContinuousUpdate | Continuous update | BOOL      | At start | TRUE, FALSE | FALSE         | Whether to enable or disable continuous change of Velocity (Velocity), Acceleration (Acceleration), and Deceleration (Deceleration) is set.<br>Continuous update re-imports input variables to the instance in execution without aborting the operation.<br>• FALSE: Disabled<br>• TRUE: Enabled |

| Input variable | Name                      | Data type                       | Input                                                          | Valid range                     | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------|---------------------------|---------------------------------|----------------------------------------------------------------|---------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LinearAxes     | Linear interpolation axis | INT[0..15]                      | At start                                                       | 1 to 16                         | 0             | The axes to be used in linear interpolation control are set from the configuration axes. Specify the index No. (1 to 16) of the configuration axes in the array.<br>* When Velocity mode (VelocityMode) is set to "2: Reference axis speed (ReferenceAxisSpeed)", the first element of the array is regarded as the reference axis.<br>For details, refer to the following.<br> Page 1748 Linear interpolation axis (LinearAxes) |
| Distance       | Movement amount           | LREAL[0..15]                    | At start                                                       | -10000000000.0 to 10000000000.0 | 0.0           | The movement amount from the current position at start to the end point is set. The value is set as one-dimensional array data. The data is treated as the relative position for configuration axes 1 to 16. For details, refer to the following.<br> Page 1749 Movement amount (Distance)                                                                                                                                       |
| Velocity       | Velocity                  | LREAL                           | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0, 0.0001 to 2500000000.0     | 0.0           | The speed command value is set. For details, refer to the following.<br> Page 1750 Velocity (Velocity)                                                                                                                                                                                                                                                                                                                           |
| Acceleration   | Acceleration              | LREAL                           | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0  | 0.0           | The acceleration is set. For details, refer to the following.<br> Page 1750 Acceleration (Acceleration)                                                                                                                                                                                                                                                                                                                          |
| Deceleration   | Deceleration              | LREAL                           | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0  | 0.0           | The deceleration is set. For details, refer to the following.<br> Page 1750 Deceleration (Deceleration)                                                                                                                                                                                                                                                                                                                        |
| Jerk           | Jerk                      | LREAL                           | At start                                                       | 0.0000, 0.0001 to 2147483647.0  | 0.0           | The jerk is set. For details, refer to the following.<br> Page 1750 Jerk (Jerk)                                                                                                                                                                                                                                                                                                                                                |
| VelocityMode   | Speed mode                | INT (MC_INTERPOLATE_SPEED_MODE) | At start                                                       | 0 to 2                          | 0             | The speed mode for interpolation control is set.<br>• 0: Vector speed (VectorSpeed)<br>• 1: Long axis speed (LongAxisSpeed)<br>• 2: Reference axis speed (ReferenceAxisSpeed)<br>For details, refer to the following.<br> Page 1751 Velocity mode (VelocityMode)                                                                                                                                                               |
| BufferMode     | Buffer mode               | INT (MC_BUFFER_MODE)            | At start                                                       | 0 to 5                          | 0             | The buffer mode is set.<br>• 0: Aborting (mcAborting)<br>• 1: Buffered (mcBuffered)<br>• 2: BlendingLow (mcBlendingLow)<br>• 3: BlendingPrevious (mcBlendingPrevious)<br>• 4: BlendingNext (mcBlendingNext)<br>• 5: BlendingHigh (mcBlendingHigh)<br>For details, refer to the following.<br> Page 1753 Buffer mode (BufferMode)                                                                                               |
| Options        | Options                   | DWORD(HEX)                      | At start                                                       | 00000000H to 00000005H          | 00000000H     | The function options for MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control) are set in the specified bit position. For details, refer to the following.<br> Page 1754 Options (Options)                                                                                                                                                                                                           |

## Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------|-----------------------|------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Completion            | BOOL       | FALSE         | This variable becomes TRUE when the control is completed.<br>The value differs depending on the status of Start (Execute) at operation completion.<br>■When Start (Execute) is TRUE<br>This variable remains TRUE until Start (Execute) is set to FALSE.<br>■When Start (Execute) is FALSE<br>This variable becomes TRUE only for one cycle.                                                                        |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control) is executed.                                                                                                                                                                                                                                                                                        |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control) is controlling the axis. When multiple MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control) FBs are executed for the same axes group, Controlling (Active) of only one MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control) FB becomes TRUE. |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control) is aborted because of an error or multiple start.                                                                                                                                                                                                                                      |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                                                                                    |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used                                                                                                                                                                                                                                                         |

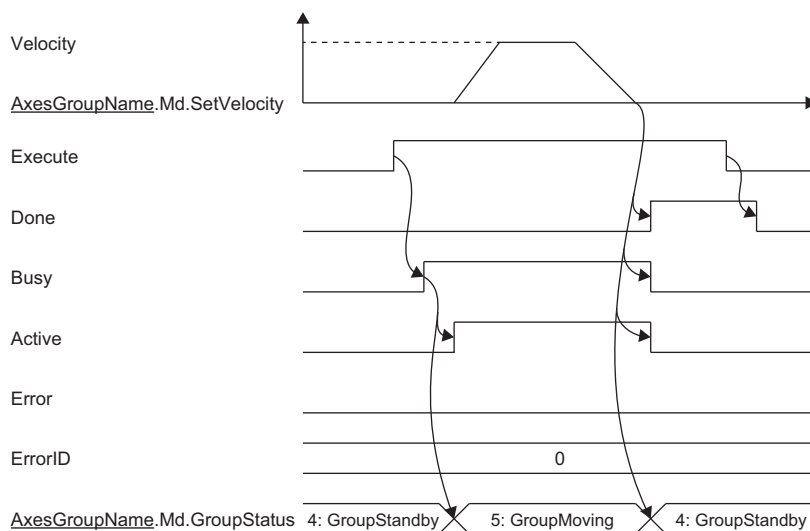
## Processing details

- This FB specifies an axes group and performs interpolation control so that the path from the start point (move start point) to the end point becomes a straight line. In linear interpolation control, interpolation control using a maximum of 4 axes is performed.
- In MCv\_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control), specify the relative movement amount from the current position and perform relative value linear interpolation control.
- For the operation of Relative Value Linear Interpolation Control for axes 1 to 3, refer to "Linear Interpolation Control" in the following.

User's manual for the controller used

## Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■ Linear interpolation axis (LinearAxes)

In linear interpolation control, linear interpolation is performed using arbitrary axes from the configuration axes set to the axes group.

Set configuration axes to perform linear interpolation by Linear interpolation axis (LinearAxes) from the configuration axes of the axes group. Linear interpolation axis (LinearAxes) has 16 array elements. For the arrays, first set only the index Nos. (1 to 16: configuration axis 1 to 16) of configuration axes to be used for interpolation control to the front, then set the rest of the arrays to "0". Arrays set to "0" can be omitted.

- The setting number of the linear interpolation axes must be set to the maximum number of the interpolation axes for interpolation control (4 axes) or less.
- The number of configuration axes to be used for interpolation control must be the number of axes registered to the configuration axes or less.
- When Velocity mode (VelocityMode) is "2: Reference axis speed (ReferenceAxisSpeed)", the configuration axis of the first element in Linear interpolation axis (LinearAxes) becomes the reference axis.
- If the following is specified, Linear Interpolation Axis Setting Incorrect (error code: 1B08H) occurs and the axis will not start.
  - When specifying a configuration axis where an axis is not set
  - When the first element of Linear interpolation axis (LinearAxes) is "0"
  - When specifying the same index No. to Linear interpolation axis (LinearAxes) in duplicate
  - When the number of axes set in Linear interpolation axis (LinearAxes) exceeds the maximum number of interpolation axes

### Ex.

When configuration axis 2, 3, and 4 are set to the linear interpolation axis

```
LinearAxes[0]:= 2;  
LinearAxes[1]:= 3;  
LinearAxes[2]:= 4;  
LinearAxes[3]:= 0; *1  
:  
LinearAxes[15]:= 0; *1
```

\*1 "LinearAxes[3]:= 0; to LinearAxes[15]:= 0;" can be omitted.

## ■ Movement amount (Distance)

Sets the movement amount from the current position at start to the end point. Movement amount (Distance) has 16 array elements.

- The input range for Movement amount (Distance) is -10000000000.0 to 10000000000.0.
- Distance[0..15] indicates the movement amount of configuration axis 1 to 16. Set the position in relation to the configuration axes set in Linear interpolation axis (LinearAxes).
- Movement amount (Distance) of configuration axes not set to the linear interpolation axes is ignored.
- Movement amount (Distance) of axes after all configuration axes set to the linear interpolation axes can be omitted.

### Ex.

When setting configuration axis 2, 3, 4 to the linear interpolation axes, and setting the target positions of configuration axis 2, 3, and 4 to 2000.0, 3000.0, and 4000.0

```
LinearAxes[0]:= 2;
LinearAxes[1]:= 3;
LinearAxes[2]:= 4;
LinearAxes[3]:= 0; *1
:
LinearAxes[15]:= 0; *1
Distance[0]:= 0.0;
Distance[1]:= 2000.0;
Distance[2]:= 3000.0;
Distance[3]:= 4000.0;
Distance[4]:= 0.0; *1
:
Distance[15]:= 0.0; *1
```

\*1 "LinearAxes[3]:= 0; to LinearAxes[15]:= 0;" and "Distance[4]:= 0.0; to Distance[15]:= 0.0;" can be omitted.

## ■Velocity (Velocity)

Sets the maximum speed of the path used in MCv\_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control).

| Setting range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.0, 0.0001 to 2500000000.0 <sup>*1,2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p>*1 To perform floating-point operation, the lower limit value of the command velocity is limited by the following restrictions.<br/>If the velocity converted from the command velocity to operation cycle is less than 0.00001, Out of Operation Cycle Converted Velocity Range (error code: 1B16H) (when changing the velocity, Out of Operation Cycle Converted Velocity Range Warning (event code: 00D2FH)) occurs. To improve the precision of floating-point operation, change Position command unit (<u>AxisName</u>.Pr.Unit_Position) and Speed command unit (<u>AxisName</u>.Pr.Unit_Velocity) and perform settings so that the velocity converted into the operation cycle is not less than "0.00001".</p> <p>*2 When a Motion control FB with a commanded velocity of "0.0" performs a multiple start, the commanded velocity of the previous Motion control FB is used.</p> |

## ■Acceleration (Acceleration)

Sets the acceleration used in MCv\_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control).

The setting range differs depending on the setting for Acceleration/deceleration method setting (Options (Options): Bit 0 to 2).

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | 0.000000 <sup>*1</sup> , positive numbers from 0.000001 to 8400.0[s]                   |

- \*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Deceleration (Deceleration)

Sets the deceleration used in MCv\_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Deceleration (Deceleration) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                               |

- \*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Jerk (Jerk)

Sets the jerk used in MCv\_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control).

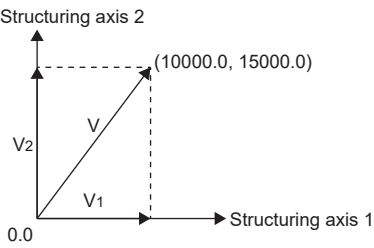
Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Jerk (Jerk) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                           |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000, positive numbers from 0.0001 to 2147483647.0[U/s <sup>3</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                |



## ■Velocity mode (VelocityMode)

Specifies the velocity mode used in linear interpolation control. When specifying "2: Reference axis speed (ReferenceAxisSpeed)" in Velocity mode (VelocityMode), the reference axis becomes the configuration axis specified to the first element of Linear interpolation axis (LinearAxes).

| Setting value                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Vector speed (VectorSpeed)      | <p>Sets Velocity (Velocity) as the vector speed.</p> <p>The positioning speed (<math>V_n</math>) of each axis is calculated from the movement amount (<math>D_n</math>) of each axis by the Motion system based on the positioning speed (<math>V</math>) of the set control target.</p> <p>&lt;Example&gt;</p> <p>When using 2-axis linear interpolation control</p>  <ul style="list-style-type: none"> <li>• Configuration axis 1 movement amount (<math>D_1</math>): 10000.0 [pulse]</li> <li>• Configuration axis 2 movement amount (<math>D_2</math>): 15000.0 [pulse]</li> <li>• Axes group speed unit: [s]</li> <li>• Vector speed (<math>V</math>): 7000.0 [pulse/s]</li> </ul> <p>For the above conditions, the positioning speed of each axis is calculated by the Motion system with the following calculation formulas.</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 positioning speed: <math>V_1 = V \times D_1 / \sqrt{D_1^2 + D_2^2}</math></li> <li>• Configuration axis 2 positioning speed: <math>V_2 = V \times D_2 / \sqrt{D_1^2 + D_2^2}</math></li> </ul> <p>■Point</p> <ul style="list-style-type: none"> <li>• For the vector speed specification, the set speed limit value is valid as the vector speed for Velocity (Velocity).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 1: Long axis speed (LongAxisSpeed) | <p>Sets Velocity (Velocity) as the velocity of the long axis.</p> <p>The control is carried out based on the positioning speed (the long axis velocity: <math>V</math>) of the interpolation axis whose movement amount is the largest in the specified positions set in each interpolation axis. The positioning speed (<math>V_n</math>) of the other interpolation axes is calculated by the Motion system from the movement amount (<math>D_n</math>) of each interpolation axis.</p> <p>&lt;Example&gt;</p> <p>When using 4-axis linear interpolation control</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 movement amount (<math>D_1</math>): 10000.0 [pulse]</li> <li>• Configuration axis 2 movement amount (<math>D_2</math>): 15000.0 [pulse]</li> <li>• Configuration axis 3 movement amount (<math>D_3</math>): 5000.0 [pulse]</li> <li>• Configuration axis 4 movement amount (<math>D_4</math>): 20000.0 [pulse]</li> <li>• Configuration axis 4 speed unit: [s]</li> <li>• Long axis speed (<math>V</math>): 7000.0 [pulse/s]</li> </ul> <p>In the above case, the long axis is configuration axis 4 whose movement amount is the largest, and the control is carried out based on the long axis velocity of configuration axis 4. The positioning speed of the other configuration axes is calculated by the Motion system with the following calculation formulas.</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 positioning speed: <math>V_1 = D_1 / D_4 \times V</math></li> <li>• Configuration axis 2 positioning speed: <math>V_2 = D_2 / D_4 \times V</math></li> <li>• Configuration axis 3 positioning speed: <math>V_3 = D_3 / D_4 \times V</math></li> </ul> <p>■Point</p> <ul style="list-style-type: none"> <li>• For the long axis speed specification, the set speed limit value is valid as the long axis velocity for Velocity (Velocity).</li> <li>• Note that the vector speed may be larger than the speed limit value when specifying Long axis speed. When a value is set as shown below in the 2-axis linear interpolation, the vector velocity exceeds the velocity limit value.</li> </ul> <p>&lt;Example&gt;</p> <p>When the setting items and the setting values are as follows.</p> <ul style="list-style-type: none"> <li>• Linear interpolation axes: Configuration axis 1, Configuration axis 2</li> <li>• Configuration axis 1 movement amount: 100 [pulses]</li> <li>• Configuration axis 2 movement amount: 200 [pulses]</li> <li>• Long axis velocity: 50 [pulses/s]</li> <li>• Velocity limit value of configuration axis 2: 55 [pulses/s]</li> </ul> <p>In the above case, the reference axis is configuration axis 2 whose movement amount is the largest, and the control is carried out with the velocity limit value set for configuration axis 2. The positioning speed and the vector velocity of each axis are shown below.</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 positioning speed: <math>100/200 \times 50 = 25</math> [pulses/s]</li> <li>• Configuration axis 2 positioning speed: 50 [pulses/s]</li> <li>• Vector velocity: <math>\sqrt{(25^2 + 50^2)} = 55.9</math> [pulses/s]</li> </ul> <p>The vector velocity becomes a value that exceeds the velocity limit value "55" of configuration axis 2.</p> |

| Setting value                                   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2: Reference axis speed<br>(ReferenceAxisSpeed) | <p>Sets Velocity (Velocity) as the velocity of the reference axis.</p> <p>The Motion system calculates the positioning speed (Vn) of the other interpolation axes from the movement amount (Dn) of each interpolation axis and performs control based on the positioning speed of the set reference axis (the reference axis velocity: V).</p> <p>If "0.0" is set for the movement amount of the configuration axis specified as the reference axis, Reference Axis Movement Amount 0 (error code: 1AFAH) occurs.</p> <p>&lt;Example&gt;</p> <p>When using 4-axis linear interpolation control</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 movement amount (D<sub>1</sub>): 10000.0 [pulse]</li> <li>• Configuration axis 2 movement amount (D<sub>2</sub>): 15000.0 [pulse]</li> <li>• Configuration axis 3 movement amount (D<sub>3</sub>): 5000.0 [pulse]</li> <li>• Configuration axis 4 movement amount (D<sub>4</sub>): 20000.0 [pulse]</li> <li>• Reference axis velocity (V): 7000.0 [pulse/s]</li> </ul> <p>In the above case, the long axis is configuration axis 4 whose movement amount is the largest, and the control is carried out based on the positioning speed set for configuration axis 4.</p> <p>The positioning speed of the other configuration axes is calculated by the Motion system with the following calculation formulas.</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 positioning speed: <math>V_1 = D_1 / D_4 \times V</math></li> <li>• Configuration axis 2 positioning speed: <math>V_2 = D_2 / D_4 \times V</math></li> <li>• Configuration axis 3 positioning speed: <math>V_3 = D_3 / D_4 \times V</math></li> </ul> <p>■Point</p> <ul style="list-style-type: none"> <li>• For the reference axis speed specification, the set speed limit value is valid as the reference axis velocity for Velocity (Velocity).</li> <li>• Note that the positioning speed may be larger than the set reference axis velocity for axes with a movement amount larger than the reference axis. When a value is set as shown below in the 2-axis linear interpolation, the positioning speed and the vector velocity of configuration axis 2 exceed the velocity limit value.</li> </ul> <p>&lt;Example&gt;</p> <p>When the setting items and the setting values are as follows.</p> <ul style="list-style-type: none"> <li>• Linear interpolation axes: Configuration axis 1, Configuration axis 2</li> <li>• Configuration axis 1 movement amount: 100 [pulses]</li> <li>• Configuration axis 2 movement amount: 200 [pulses]</li> <li>• Reference axis velocity: 50 [pulses/s]</li> <li>• Velocity limit value of configuration axis 1: 55 [pulses/s]</li> </ul> <p>In the above case, the reference axis is configuration axis 1, and control is carried out with the velocity limit value set for configuration axis 1. The positioning speed and the vector velocity of each axis are shown below.</p> <ul style="list-style-type: none"> <li>• Configuration axis 1 positioning speed: 50 [pulses/s]</li> <li>• Configuration axis 2 positioning speed: <math>200/100 \times 50 = 100</math> [pulses/s]</li> <li>• Vector velocity: <math>\sqrt{(50^2 + 100^2)} = 111.8</math> [pulses/s]</li> </ul> <p>The positioning speed and the vector velocity of configuration axis 2 become a value that exceeds the velocity limit value "55" of configuration axis 1.</p> |

### Restriction

- When "0: Vector speed (VectorSpeed)" is set in Velocity mode (VelocityMode) and the movement value of each axis exceeds "4,294,967,296.0 (=2<sup>32</sup>)", Out of Linear Movement Amount Range (error code: 1B10H) will occur and the axis will not start.
- When "0: Aborting (mcAborting)" is set in Buffer mode (BufferMode) and MCv\_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control) is executed by multiple start, specify "0: Vector speed (VectorSpeed)" in Velocity mode (VelocityMode). If a value other than "0: Vector speed (VectorSpeed)" is set, Out of Speed Mode Range (error code: 1AC9H) occurs.

## ■ Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following buffer modes are settable in MCv\_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control).

| Setting value                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting)                 | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                                                                                                                                                                                                              |
| 1: Buffered (mcBuffered)                 | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB.                                                                                                                                                                                        |
| 2: BlendingLow (mcBlendingLow)           | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the lower target velocity between the under-control FB and the buffering FB is used as the switching speed.  |
| 3: BlendingPrevious (mcBlendingPrevious) | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the under-control FB is used as the switching speed.                                  |
| 4: BlendingNext (mcBlendingNext)         | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the buffering FB is used as the switching speed.                                      |
| 5: BlendingHigh (mcBlendingHigh)         | Buffers the next FB on the under-control FB.*1<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the higher target velocity between the under-control FB and the buffering FB is used as the switching speed. |

\*1 Stops are not performed between the under-control FB and the buffering FB.



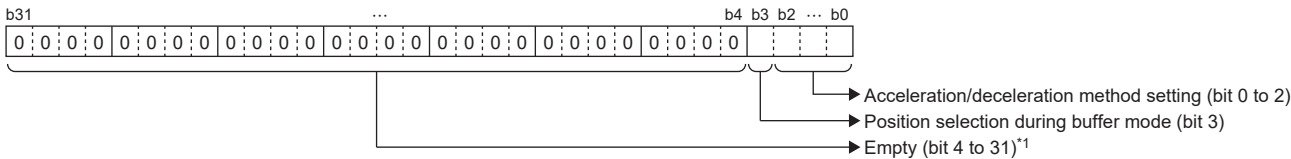
For details on multiple start (buffer mode), refer to the following.

User's manual for the controller used

## Options (Options)

The function options for MCv\_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit    | Name                                            | Description                                                                                                                                                                                                                                                                     |
|--------|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 2 | Acceleration/<br>deceleration method<br>setting | Sets the acceleration/deceleration method used to perform control. <ul style="list-style-type: none"><li>• 0: Acceleration/deceleration specification method (mcAccDec)</li><li>• 1: Acceleration/deceleration time-fixed method (mcFixedTime)</li></ul>                        |
| 3      | Position selection during<br>buffer mode        | Sets the position when executing relative positioning control by multiple start. <ul style="list-style-type: none"><li>• 0: Set position</li><li>• 1: Actual position</li></ul> <p>* This bit is valid when setting "0: Aborting (mcAborting)" in Buffer mode (BufferMode).</p> |

### • Acceleration/deceleration method setting (Bit 0 to 2)

| Setting value                                                   | Description                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration<br>specification method (mcAccDec) | An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) set in MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control).                                                                                                                      |
| 1: Acceleration/deceleration time-fixed<br>method (mcFixedTime) | An acceleration/deceleration method using the acceleration/deceleration time specified in MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control) regardless of the velocity. The acceleration/deceleration time does not use Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). |

### • Position selection during buffer mode (Bit 3)

| Setting value      | Description                                                                                                                                                                                                                                                                                                                                                   |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Set position    | <p>Performs relative positioning control from the set position.</p> <p>&lt;Example&gt;</p> <p>When multiple start is performed with Movement amount (Distance) set to "5000.0" and Options (Options) set to "00000000H (Bit 3 is 0: Set position)"</p> <p>The position moves only the movement amount (Distance) according to the set position.</p>           |
| 1: Actual position | <p>Performs relative positioning control from the actual position.</p> <p>&lt;Example&gt;</p> <p>When multiple start is performed with Movement amount (Distance) set to "5000.0" and Options (Options) set to "00000008H (Bit 3 is 1: Actual position)".</p> <p>The position moves only the movement amount (Distance) according to the actual position.</p> |

## ■ Necessary object data

When using MCv\_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control), set the following object data for all configuration axes in the specified axes group.

- Target position (607AH)

If there is a configuration axis where object data is not set, Necessary Slave Object Unset (error code: 1AF7H) occurs and the axis will not start.

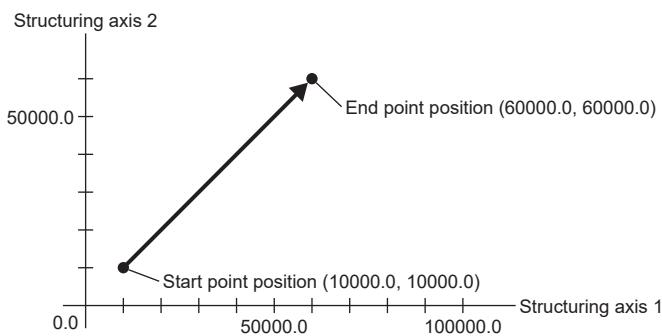
For details on object data settings, refer to the following.

📖 User's manual for the controller used

## Program example

The following is a program example. The linear interpolation control start (bLinearInterpolateCMD) is set to TRUE, and Axes group 1 (AxesGroup001) is enabled. Then, 2-axis linear interpolation relative positioning control is performed for Axis group 1 (AxesGroup001).

- Operation



- Axes group

| Item                  | Setting value |
|-----------------------|---------------|
| Configuration axis[1] | Axis0001      |
| Configuration axis[2] | Axis0002      |

- Setting

| Item            | Setting value        |                      |
|-----------------|----------------------|----------------------|
|                 | Configuration axis 1 | Configuration axis 2 |
| Target position | 50000.0              | 50000.0              |
| Velocity        | 50000.0              |                      |
| Acceleration    | 50000.0              |                      |
| Deceleration    | 50000.0              |                      |
| Jerk            | 0.0                  |                      |

## ■ Axes

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |
| 2        | Axis0002   | AXIS_REF  | Axis 2  |

## ■ Axes group

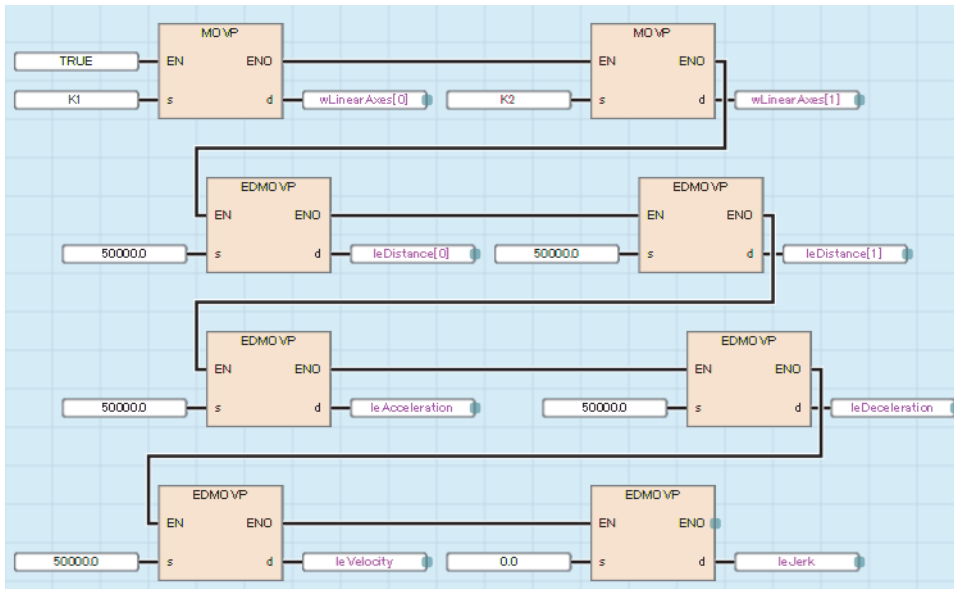
| Axes group No. | Label name   | Data type      | Comment      |
|----------------|--------------|----------------|--------------|
| 1              | AxesGroup001 | AXES_GROUP_REF | Axes group 1 |

## ■Labels used

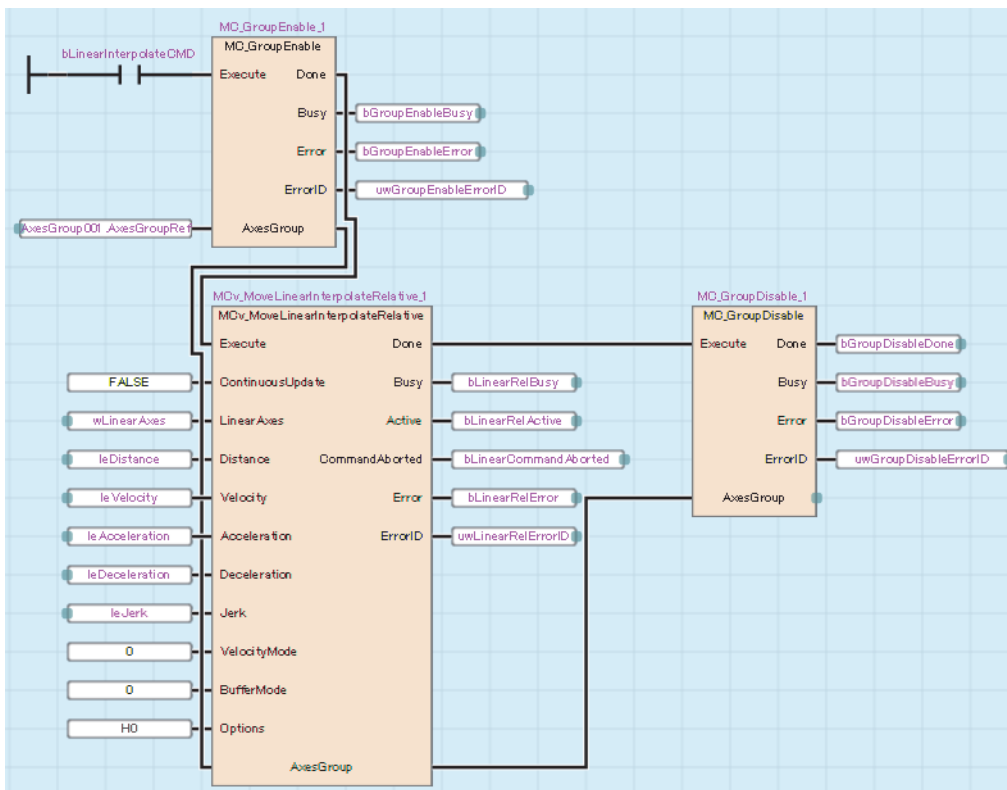
| Label name                          | Data type                           | Comment                                        |
|-------------------------------------|-------------------------------------|------------------------------------------------|
| MCv_MoveLinearInterpolateRelative_1 | MCv_MoveLinearInterpolateRelative   | Relative Value Linear Interpolation Control FB |
| wLinearAxes                         | Word [signed](0..15)                | Linear interpolation axis                      |
| leDistance                          | Double-precision real number(0..15) | Movement amount                                |
| leVelocity                          | Double-precision real number        | Velocity                                       |
| leAcceleration                      | Double-precision real number        | Acceleration                                   |
| leDeceleration                      | Double-precision real number        | Deceleration                                   |
| leJerk                              | Double-precision real number        | Jerk                                           |
| bLinearRelDone                      | Bit                                 | Execution completion                           |
| bLinearRelBusy                      | Bit                                 | Executing                                      |
| bLinearRelActive                    | Bit                                 | Controlling                                    |
| bLinearCommandAborted               | Bit                                 | Abortion of execution                          |
| bLinearRelError                     | Bit                                 | Error                                          |
| uwLinearRelErrorID                  | Word [unsigned]/bit string [16-bit] | Error code                                     |
| MC_GroupEnable_1                    | MC_GroupEnable                      | Axes Group Enabled FB                          |
| bLinearInterpolateCMD               | Bit                                 | Linear interpolation control start             |
| bGroupEnableDone                    | Bit                                 | Axes Group Enabled Completion                  |
| bGroupEnableBusy                    | Bit                                 | Executing                                      |
| bGroupEnableError                   | Bit                                 | Error                                          |
| uwGroupEnableErrorID                | Word [unsigned]/bit string [16-bit] | Error code                                     |
| MC_GroupDisable_1                   | MC_GroupDisable                     | Axes Group Disabled FB                         |
| bGroupDisableDone                   | Bit                                 | Axes Group Disabled Completion                 |
| bGroupDisableBusy                   | Bit                                 | Executing                                      |
| bGroupDisableError                  | Bit                                 | Error                                          |
| uwGroupDisableErrorID               | Word [unsigned]/bit string [16-bit] | Error code                                     |

## ■FBD/LD program

- Data setting for 2-axis linear interpolation control



- Axes Group Enabled/2-axis linear interpolation control/Axes Group Disabled



## ■ST program

```
//-----Data setting for 2-axis linear interpolation control-----
wLinearAxes[0]:= 1;
wLinearAxes[1]:= 2;
leDistance[0]:= 50000.0;
leDistance[1]:= 50000.0;
leVelocity:= 50000.0;
leAcceleration:= 50000.0;
leDeceleration:= 50000.0;
leJerk:= 0.0;

//-----Axes Group Enabled-----
MC_GroupEnable_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bLinearInterpolateCMD ,
  Done=> bGroupEnableDone ,
  Busy=> bGroupEnableBusy ,
  Error=> bGroupEnableError ,
  ErrorID=> uwGroupEnableErrorID
);

//-----2-axis linear interpolation control-----
MCv_MoveLinearInterpolateRelative_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bGroupEnableDone ,
  ContinuousUpdate:= FALSE ,
  LinearAxes:= wLinearAxes ,
  Distance:= leDistance ,
  Velocity:= leVelocity ,
  Acceleration:= leAcceleration ,
  Deceleration:= leDeceleration ,
  Jerk:= leJerk ,
  VelocityMode:= MC_INTERPOLATE_SPEED_MODE__VectorSpeed ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= H00000000 ,
  Done=> bLinearRelDone ,
  Busy=> bLinearRelBusy ,
  Active=> bLinearRelActive ,
  CommandAborted=> bLinearRelCommandAborted ,
  Error=> bLinearRelError ,
  ErrorID=> uwLinearRelErrorID
);

//-----Axes Group Disabled-----
MC_GroupDisable_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bLinearRelDone ,
  Done=> bGroupDisableDone ,
  Busy=> bGroupDisableBusy ,
  Error=> bGroupDisableError ,
  ErrorID=> uwGroupDisableErrorID
);
```



# 46.12 Absolute Value Circular Interpolation Control

46

## MCv\_MoveCircularInterpolateAbsolute

This FB performs positioning with 2-axis circular interpolation using the configuration axes of the set axes group by setting the end point and sub point of the absolute position.

| Ladder                                                                                                                                                                                                                                                                                                                                                            | FBD/LD                                                                                                                                                                                                                                                             | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div> MCv_MoveCircularInterpolateAbsolute DUT: AxesGroup ——— AxesGroup :DUT B: Execute Done :B B: ContinuousUpdate Busy :B W: CircAxes Active :B ENUM: CircMode CommandAborted :B L: AuxPoint Error :B L: EndPoint ErrorID :UW ENUM: PathChoice L: Velocity L: Acceleration L: Deceleration L: Jerk L: CircularErrorTolerance ENUM: BufferMode UD: Options </div> | <div> MCv_MoveCircularInterpolateAbsolute Execute Done ContinuousUpdate Busy CircAxes Active CircMode CommandAborted AuxPoint Error EndPoint ErrorID PathChoice Velocity Acceleration Deceleration Jerk CircularErrorTolerance BufferMode Options AxesGroup </div> | MCv_MoveCircularInterpolateAbsolute(<br>AxesGroup:= ?AXES_GROUP_REF? ,<br>Execute:= ?BOOL? ,<br>ContinuousUpdate:= ?BOOL? ,<br>CircAxes:= ?INT(0..1)? ,<br>CircMode:= ?INT? ,<br>AuxPoint:= ?LREAL(0..15)? ,<br>EndPoint:= ?LREAL(0..15)? ,<br>PathChoice:= ?INT? ,<br>Velocity:= ?LREAL? ,<br>Acceleration:= ?LREAL? ,<br>Deceleration:= ?LREAL? ,<br>Jerk:= ?LREAL? ,<br>CircularErrorTolerance:= ?LREAL? ,<br>BufferMode:= ?INT? ,<br>Options:= ?DWORD? ,<br>Done=> ?BOOL? ,<br>Busy=> ?BOOL? ,<br>Active=> ?BOOL? ,<br>CommandAborted=> ?BOOL? ,<br>Error=> ?BOOL? ,<br>ErrorID=> ?WORD?<br>); |

### Setting data

#### I/O variables

| I/O variable | Name                   | Data type          | Input    | Valid range | Default value            | Description                                                                                                                                                                                         |
|--------------|------------------------|--------------------|----------|-------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxesGroup    | Axes group information | AXES_GROU<br>P_REF | At start | —           | Omission<br>not possible | An axes group is set.<br>For the variable<br>( <u>AxesGroupName.AxesGroupRef.</u> ) used,<br>refer to the following.<br>Page 1468<br><u>AxesGroupName.AxesGroupRef.</u> (Axes<br>group information) |

## ■Input variable

| Input variable   | Name                        | Data type          | Input    | Valid range                                                                                                                                                                                                                              | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------|-----------------------------|--------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute          | Start                       | BOOL               | At start | TRUE, FALSE                                                                                                                                                                                                                              | FALSE         | When this variable is set to TRUE, MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control) is executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| ContinuousUpdate | Continuous update           | BOOL               | At start | TRUE, FALSE                                                                                                                                                                                                                              | FALSE         | Whether to enable or disable continuous change of Velocity (Velocity), Acceleration (Acceleration), and Deceleration (Deceleration) is set.<br>Continuous update re-imports input variables to the instance in execution without aborting the operation.<br><ul style="list-style-type: none"> <li>• FALSE: Disabled</li> <li>• TRUE: Enabled</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| CircAxes         | Circular interpolation axis | INT[0..1]          | At start | 1 to 16                                                                                                                                                                                                                                  | 0             | The axes to be used in circular interpolation control are set from the configuration axes. Specify the index No. (1 to 16) of the configuration axes in the array. The first element of the array is regarded as the reference axis.<br>For details, refer to the following.<br> Page 1763 Circular interpolation axis (CircAxes)                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| CircMode         | Circular interpolation mode | INT (MC_CIRC_MODE) | At start | 0 to 2                                                                                                                                                                                                                                   | 0             | The circular interpolation specification method is set.<br><ul style="list-style-type: none"> <li>• 0: Border point specification (mcBorder)</li> <li>• 1: Center point specification (mcCenter)</li> <li>• 2: Radius specification (mcRadius)</li> </ul> For details, refer to the following.<br> Page 1763 Circular interpolation mode (CircMode)                                                                                                                                                                                                                                                                                                                                                                                                                            |
| AuxPoint         | Sub point                   | LREAL[0..15]       | At start | <p>■When "0: Border point specification (mcBorder)" or "1: Center point specification (mcCenter)" is set:<br/>-10000000000.0 to 10000000000.0</p> <p>■When "2: Radius specification (mcRadius)" is set:<br/>0.000001 to 2147483647.0</p> | 0.0           | The absolute position of the sub point (border point, center point, and radius) according to unit of the axis is set.<br>The value is set as one-dimensional array data. The set value differs depending on the setting of Circular interpolation mode (CircMode).<br><p>■When "0: Border point specification (mcBorder)" or "1: Center point specification (mcCenter)" is set:<br/>The data is treated as the absolute position for configuration axes 1 to 16. The absolute positions of the border point and center point are set.</p> <p>■When "2: Radius specification (mcRadius)" is set:<br/>The first element is treated as the radius and the second and subsequent elements are ignored.</p> For details, refer to the following.<br> Page 1764 Sub point (AuxPoint) |
| EndPoint         | End point                   | LREAL[0..15]       | At start | -10000000000.0 to 10000000000.0                                                                                                                                                                                                          | 0.0           | The position of the end point is set.<br>The value is set as one-dimensional array data. The data is treated as the absolute position for configuration axes 1 to 16.<br>For details, refer to the following.<br> Page 1764 End point (EndPoint)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

| Input variable         | Name                                   | Data type                | Input                                                          | Valid range                    | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------|----------------------------------------|--------------------------|----------------------------------------------------------------|--------------------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PathChoice             | Path selection                         | INT (MC_CIRC_PATHCHOICE) | At start                                                       | 0 to 5                         | 0             | <p>The rotation direction of the circular interpolation is set.</p> <ul style="list-style-type: none"> <li>• 0: CW (mcCW)</li> <li>• 1: CCW (mcCCW)</li> <li>• 2: Shortcut (mcShortWay)</li> <li>• 3: Detour (mcLongWay)</li> <li>• 4: CW Detour (mcCWLongWay)</li> <li>• 5: CCW Detour (mcCCWLongWay)</li> </ul> <p>* When Circular interpolation mode (CircMode) is set to "0: Border point specification (mcBorder)", the input is ignored.</p> <p>* When Circular interpolation mode (CircMode) is set to "2: Radius specification (mcRadius)", "0: CW (mcCW)" means the CW shortcut and "1: CCW (mcCCW)" means the CCW shortcut.</p> <p>For details, refer to the following.</p> <p> Page 1765 Path selection (PathChoice)</p> |
| Velocity               | Velocity                               | LREAL                    | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0, 0.0001 to 2500000000.0    | 0.0           | <p>The speed command value is set.</p> <p>For details, refer to the following.</p> <p> Page 1766 Velocity (Velocity)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Acceleration           | Acceleration                           | LREAL                    | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | <p>The acceleration is set.</p> <p>For details, refer to the following.</p> <p> Page 1766 Acceleration (Acceleration)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Deceleration           | Deceleration                           | LREAL                    | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | <p>The deceleration is set.</p> <p>For details, refer to the following.</p> <p> Page 1767 Deceleration (Deceleration)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Jerk                   | Jerk                                   | LREAL                    | At start                                                       | 0.0000, 0.0001 to 2147483647.0 | 0.0           | <p>The jerk is set.</p> <p>For details, refer to the following.</p> <p> Page 1767 Jerk (Jerk)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| CircularErrorTolerance | Circular interpolation error tolerance | LREAL                    | At start                                                       | 0.000001 to 100000.0           | 100.0         | <p>The allowable range of circular interpolation errors is set.</p> <p>For details, refer to the following.</p> <p> Page 1767 Circular interpolation error tolerance (CircularErrorTolerance)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| BufferMode             | Buffer mode                            | INT (MC_BUFFER_MODE)     | At start                                                       | 0 to 5                         | 0             | <p>The buffer mode is set.</p> <ul style="list-style-type: none"> <li>• 0: Aborting (mcAborting)</li> <li>• 1: Buffered (mcBuffered)</li> <li>• 2: BlendingLow (mcBlendingLow)</li> <li>• 3: BlendingPrevious (mcBlendingPrevious)</li> <li>• 4: BlendingNext (mcBlendingNext)</li> <li>• 5: BlendingHigh (mcBlendingHigh)</li> </ul> <p>For details, refer to the following.</p> <p> Page 1768 Buffer mode (BufferMode)</p>                                                                                                                                                                                                                                                                                                      |
| Options                | Options                                | DWORD(HEX)               | At start                                                       | 00000000H to 00000001H         | 00000000H     | <p>The function options for MC_V_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control) are set in the specified bit position.</p> <p>For details, refer to the following.</p> <p> Page 1768 Options (Options)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## ■Output variables

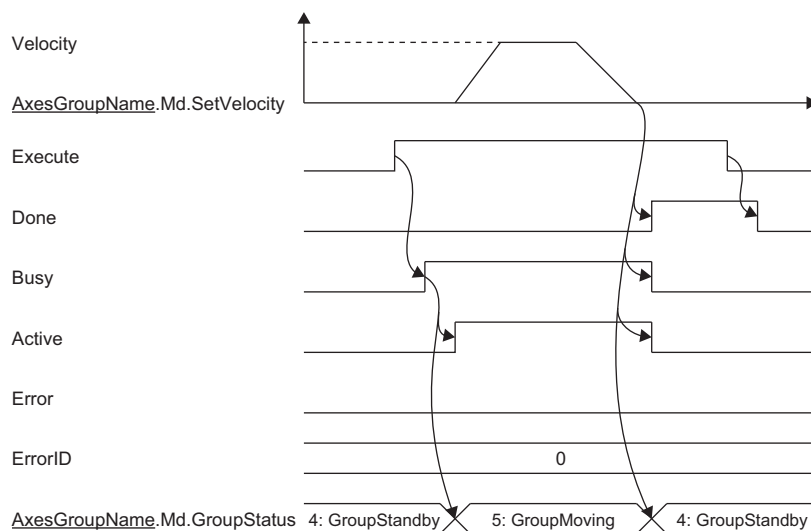
| Output variable | Name                  | Data type   | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------|-----------------------|-------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Completion            | BOOL        | FALSE         | This variable becomes TRUE when the control is completed.<br>The value differs depending on the status of Start (Execute) at operation completion.<br>■When Start (Execute) is TRUE<br>This variable remains TRUE until Start (Execute) is set to FALSE.<br>■When Start (Execute) is FALSE<br>This variable becomes TRUE only for one cycle.                                                                                       |
| Busy            | Executing             | BOOL        | FALSE         | This variable becomes TRUE when MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control) is executed.                                                                                                                                                                                                                                                                                                   |
| Active          | Controlling           | BOOL        | FALSE         | This variable becomes TRUE while MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control) is controlling the axis.<br>When multiple MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control) FBs are executed for the same axes group, Controlling (Active) of only one MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control) FB becomes TRUE. |
| CommandAborted  | Abortion of execution | BOOL        | FALSE         | This variable becomes TRUE when execution of MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control) is aborted because of an error or multiple start.                                                                                                                                                                                                                                                 |
| Error           | Error                 | BOOL        | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                                                                                                   |
| ErrorID         | Error code            | WORD(UINT ) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                                                                                                                                                                      |

## Processing details

- This FB specifies an axes group and performs interpolation control mechanically so that the path from the start point (move start point) to the end point forms an arc for a linear axis which is orthogonally arranged.
- In circular interpolation control, interpolation control is performed using two arbitrary axes from the configuration axes set to the axes group.
- For circular interpolation control, the border point specification, center point specification, and radius specification circular interpolation methods are settable.
- In MCv\_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control), 2-axis circular interpolation control is performed by specifying the end point or sub point of the absolute position.

## ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

### ■Circular interpolation axis (CircAxes)

In circular interpolation control, circular interpolation is performed by using two arbitrary axes from the configuration axes set to the axes group.

The axes used to perform circular interpolation are specified from the configuration axes in the axes group by using Circular interpolation axis (CircAxes). The Circular interpolation axis (CircAxes) has two array elements. For the arrays, specify the index Nos. (1 to 16: configuration axis 1 to 16) of configuration axes to be used for interpolation control.

The first element of the array is regarded as the reference axis.

If the configuration axis specified does not have an axis set, Circular Interpolation Axis Unset (error code: 1ACAH) occurs.

#### Ex.

When setting configuration axes 2 and 3 as the circular interpolation axes

```
CircAxes[0]:= 2;
```

```
CircAxes[1]:= 3;
```

### ■Circular interpolation mode (CircMode)

Sets the circular interpolation method (border point specification, center point specification, or radius specification) used to perform circular interpolation control.

The contents set in Sub point (AuxPoint) differ depending on the setting of Circular interpolation mode (CircMode).

| Setting value                               | Sub point (AuxPoint)                                                                                                                                                                                                                                                                 |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Border point specification<br>(mcBorder) | Sub point (AuxPoint) sets the border point on the arc connecting the start point and the end point.<br>Positioning control with arc path that passes through the specified border point is performed using the two configuration axes set in Circular interpolation axis (CircAxes). |
| 1: Center point specification<br>(mcCenter) | Sub point (AuxPoint) sets the center point of the arc.<br>Positioning control with an arc path having the center point at its center is performed using the two configuration axes set in Circular interpolation axis (CircAxes).                                                    |
| 2: Radius specification<br>(mcRadius)       | Sub point (AuxPoint) sets the radius of the arc.<br>Positioning control with an arc path having the specified radius is performed using the two configuration axes set in Circular interpolation axis (CircAxes).                                                                    |

For the operation of each circular interpolation control set in Circular interpolation mode (CircMode), refer to the following.

 User's manual for the controller used

## ■Sub point (AuxPoint)

Sets the position of the sub point (border point, center point, or radius) used to perform circular interpolation.

Sub point (AuxPoint) has 16 array elements. The contents set in Sub point (AuxPoint) differ depending on the setting of Circular interpolation mode (CircMode).

| Circular interpolation mode (CircMode)   | Setting range                                            | Sub point (AuxPoint) setting                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Border point specification (mcBorder) | -10000000000.0 ≤ Set value < 10000000000.0 <sup>*1</sup> | Sub point (AuxPoint) sets the border point on the arc connecting the start point and the end point.<br>AuxPoint[0..15] indicates the sub point position of configuration axis 1 to 16.<br><ul style="list-style-type: none"> <li>Sub point (AuxPoint) of configuration axes not set to the circular interpolation axes is ignored.</li> <li>Sub point (AuxPoint) of axes after all configuration axes set to the circular interpolation axes can be omitted.</li> </ul> |
| 1: Center point specification (mcCenter) |                                                          | Sub point (AuxPoint) sets the center point of the arc.<br>AuxPoint[0..15] indicates the sub point position of configuration axis 1 to 16.<br><ul style="list-style-type: none"> <li>Sub point (AuxPoint) of configuration axes not set to the circular interpolation axes is ignored.</li> <li>Sub point (AuxPoint) of axes after all configuration axes set to the circular interpolation axes can be omitted.</li> </ul>                                              |
| 2: Radius specification (mcRadius)       | 0.000001 to 2147483647.0                                 | Sub point (AuxPoint) sets the radius of the arc.<br>AuxPoint[0] indicates the radius of the circle.<br><ul style="list-style-type: none"> <li>Inputs after AuxPoint[1] are ignored and can be omitted.</li> </ul>                                                                                                                                                                                                                                                       |

\*1 When the ring counter is enabled, the ring counter range is used.

### Ex.

When setting configuration axis 2 and 3 to the circular interpolation axes and setting the absolute position of the sub point for configuration axis 2 and 3 as 2000.0 and 3000.0

```
CircAxes[0]:= 2;
CircAxes[1]:= 3;
AuxPoint[0]:= 0.0;
AuxPoint[1]:= 2000.0;
AuxPoint[2]:= 3000.0;
AuxPoint[3]:= 0.0; *2
⋮
AuxPoint[15]:= 0.0; *2
```

\*2 "AuxPoint[3]:= 0.0; to AuxPoint[15]:= 0.0;" can be omitted.

## ■End point (EndPoint)

Sets the end point of the absolute position.

End point (EndPoint) has 16 array elements. EndPoint[0..15] indicates the end point position of configuration axis 1 to 16.

- End point (EndPoint) for configuration axes which are not set to the circular interpolation axis are ignored.
- End point (EndPoint) after all of the configuration axes which are set to the circular interpolation axis can be omitted.

Set End point (EndPoint) within the following range.

| Setting range                                            |
|----------------------------------------------------------|
| -10000000000.0 ≤ Set value < 10000000000.0 <sup>*1</sup> |

\*1 When the ring counter is enabled, the ring counter range is used.

## ■Path selection (PathChoice)

Sets the rotation direction for circular interpolation. For the rotation direction, the first element of the array set in Circular interpolation axis (CircAxes) is regarded as the reference axis.

Path selection (PathChoice) is set when Circular interpolation mode (CircMode) is set to "1: Center point specification (mcCenter)" or "2: Radius specification (mcRadius)". When "0: Border point specification (mcBorder)" is set, this input is omitted.

The following shows the setting value, setting description, arc center angle that can be controlled, and path of Path selection (PathChoice) according to the setting of Circular interpolation mode (CircMode).

- Path for "1: Center point specification (mcCenter)"

| Setting value            | Setting description                                                                                                                                                                                                                                                                                                     | Arc center angle that can be controlled | Path |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------|
| 0: CW (mcCW)             | CW                                                                                                                                                                                                                                                                                                                      | $0^\circ < \theta \leq 360^\circ$       |      |
| 1: CCW (mcCCW)           | CCW                                                                                                                                                                                                                                                                                                                     | $0^\circ < \theta \leq 360^\circ$       |      |
| 2: Shortcut (mcShortWay) | Shortcut <ul style="list-style-type: none"> <li>• When the start point, center point, and end point are on one straight line, becomes CW. (A semicircle is drawn in the CW direction.)</li> <li>• If the start point is the same as the end point, Path Choice Setting Incorrect (error code: 1B06H) occurs.</li> </ul> | $0^\circ < \theta \leq 180^\circ$       |      |
| 3: Detour (mcLongWay)    | Detour <ul style="list-style-type: none"> <li>• When the start point, center point, and end point are on one straight line, becomes CW. (A semicircle is drawn in the CW direction.)</li> <li>• When the start point is same as the end point, becomes CW. (A perfect circle is drawn in CW direction.)</li> </ul>      | $180^\circ \leq \theta \leq 360^\circ$  |      |

- Path for "2: Radius specification (mcRadius)"

| Setting value                | Setting description                                                                                                                                         | Arc center angle that can be controlled | Path |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------|
| 0: CW (mcCW)                 | CW (CW shortcut)<br>• If the start point, center point, and end point are on one straight line, Path Choice Setting Incorrect (error code: 1B06H) occurs.   | $0^\circ < \theta < 180^\circ$          |      |
| 1: CCW (mcCCW)               | CCW (CCW shortcut)<br>• If the start point, center point, and end point are on one straight line, Path Choice Setting Incorrect (error code: 1B06H) occurs. | $0^\circ < \theta < 180^\circ$          |      |
| 4: CW Detour (mcCWLongWay)   | CW detour<br>• When the start point, end point, and center point are on one straight line, a semicircle is drawn.                                           | $180^\circ \leq \theta < 360^\circ$     |      |
| 5: CCW Detour (mcCCWLongWay) | CCW detour<br>• When the start point, end point, and center point are on one straight line, a semicircle is drawn.                                          | $180^\circ \leq \theta < 360^\circ$     |      |

## ■Velocity (Velocity)

Sets the maximum speed of the path used in MCv\_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control).

| Setting range                               |
|---------------------------------------------|
| 0.0, 0.0001 to 2500000000.0 <sup>*1,2</sup> |

- \*1 To perform floating-point operation, the lower limit value of the command velocity is limited by the following restrictions.  
If the velocity converted from the command velocity to operation cycle is less than 0.00001, Out of Operation Cycle Converted Velocity Range (error code: 1B16H) (when changing the velocity, Out of Operation Cycle Converted Velocity Range Warning (event code: 00D2FH)) occurs. To improve the precision of floating-point operation, change Position command unit (AxisName.Pr.Unit\_Position) and Speed command unit (AxisName.Pr.Unit\_Velocity) and perform settings so that the velocity converted into the operation cycle is not less than "0.00001".
- \*2 When a Motion control FB with a commanded velocity of "0.0" performs a multiple start, the commanded velocity of the previous Motion control FB is used.

## ■Acceleration (Acceleration)

Sets the acceleration used in MCv\_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control).

The setting range differs depending on the setting for Acceleration/deceleration method setting (Options (Options): Bit 0 to 2).

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | 0.000000 <sup>*1</sup> , positive numbers from 0.000001 to 8400.0[s]                   |

- \*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.



## ■Deceleration (Deceleration)

Sets the deceleration used in MCv\_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Deceleration (Deceleration) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                               |

\*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Jerk (Jerk)

Sets the jerk used in MCv\_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control).

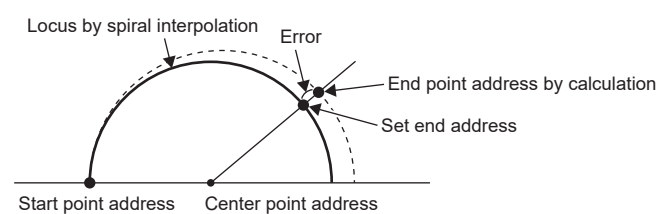
Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Jerk (Jerk) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                           |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000, positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                |

## ■Circular interpolation error tolerance (CircularErrorTolerance)

In circular interpolation control with center point specification, the arc path calculated from the start position and center position may deviate from the end position set in End point (EndPoint).

Circular interpolation error tolerance (CircularErrorTolerance) sets the allowable width of errors between the calculated arc path and the end position.

| Setting range                                                                      | Description                                                                                                                                                                                                                               |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculated error ≤ Circular interpolation error tolerance (CircularErrorTolerance) | <p>Circular interpolation control to the set end point address is performed while the error compensation is carried out by spiral interpolation.</p>  |
| Calculated error > Circular interpolation error tolerance (CircularErrorTolerance) | <p>At the positioning start, Circular Interpolation Error Allowable Value Over (error code: 1AD9H) occurs and the control will not start. The operation will immediately stop if the error is detected during positioning control.</p>    |

## ■Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following buffer modes are settable in MCv\_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control).

| Setting value                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting)                 | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                                                                                                                                                                                                                          |
| 1: Buffered (mcBuffered)                 | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB.                                                                                                                                                                                                    |
| 2: BlendingLow (mcBlendingLow)           | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the lower target velocity between the under-control FB and the buffering FB is used as the switching speed.  |
| 3: BlendingPrevious (mcBlendingPrevious) | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the under-control FB is used as the switching speed.                                  |
| 4: BlendingNext (mcBlendingNext)         | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the buffering FB is used as the switching speed.                                      |
| 5: BlendingHigh (mcBlendingHigh)         | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the higher target velocity between the under-control FB and the buffering FB is used as the switching speed. |

\*<sup>1</sup> Stops are not performed between the under-control FB and the buffering FB.

### Point

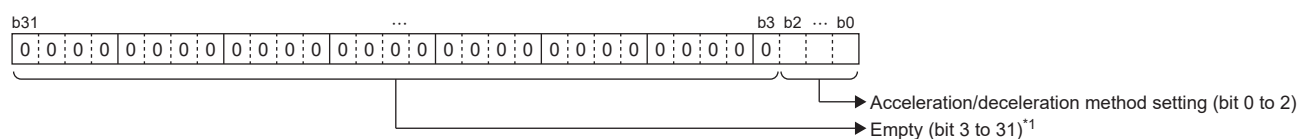
For details on multiple start (buffer mode), refer to the following.

📖 User's manual for the controller used

## ■Options (Options)

The function options for MCv\_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*<sup>1</sup> Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit    | Name                                            | Description                                                                                                                                                                                            |
|--------|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 2 | Acceleration/<br>deceleration method<br>setting | Sets the acceleration/deceleration method used to perform control.<br>• 0: Acceleration/deceleration specification method (mcAccDec)<br>• 1: Acceleration/deceleration time-fixed method (mcFixedTime) |

• Acceleration/deceleration method setting (Bit 0 to 2)

| Setting value                                                | Description                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec) | An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) set in MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control).                                                                                                                      |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime) | An acceleration/deceleration method using the acceleration/deceleration time specified in MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control) regardless of the velocity. The acceleration/deceleration time does not use Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). |

## ■ Necessary object data

When using MCv\_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control), set the following object data for all configuration axes in the specified axes group.

- Target position (607AH)

If there is a configuration axis where object data is not set, Necessary Slave Object Unset (error code: 1AF7H) occurs and the axis will not start.

For details on object data settings, refer to the following.

📖 User's manual for the controller used

## Precautions

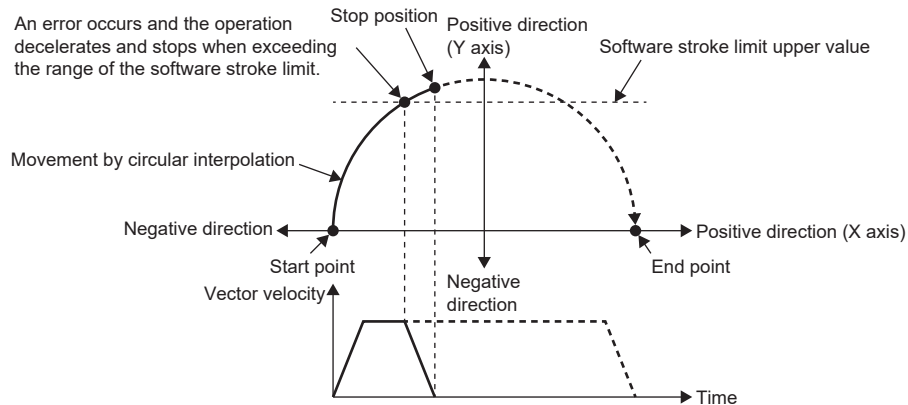
- Circular interpolation including an axis whose stroke limit is set to invalid cannot be performed. Software stroke limit invalid at circular interpolation (error code: 1ADAH) occurs and the operation does not start.
- When the interpolation path exceeds the stroke limit range during interpolation operation, Software stroke limit over (forward direction) (error code: 1A83H) or Software stroke limit over (reverse direction) (error code: 1A84H) occurs and the operation will stop.

### Ex.

When the upper limit of the software stroke limit is exceeded in the positive direction of the Y-axis

For an immediate stop, stops at the same time that the error occurs.

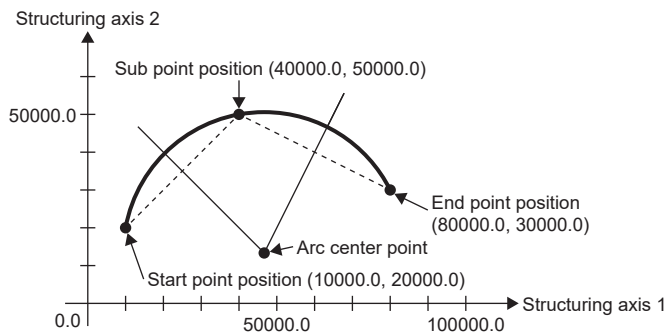
For a deceleration stop, decelerates to a stop along the arc of the circle as shown below.



## Program example

The following is a program example. The circular interpolation control start (bCircularInterpolateCMD) is set to TRUE, and Axes group 1 (AxesGroup001) is enabled. Then, 2-axis circular interpolation (sub point specification) absolute positioning control is performed for Axis group 1 (AxesGroup001).

### • Operation



### • Axes group

| Item                  | Setting value |
|-----------------------|---------------|
| Configuration axis[1] | Axis0001      |
| Configuration axis[2] | Axis0002      |

### • Setting

| Item                                   | Setting value        |                      |
|----------------------------------------|----------------------|----------------------|
|                                        | Configuration axis 1 | Configuration axis 2 |
| Sub point                              | 40000.0              | 50000.0              |
| End point                              | 80000.0              | 30000.0              |
| Velocity                               | 50000.0              |                      |
| Acceleration                           | 50000.0              |                      |
| Deceleration                           | 50000.0              |                      |
| Jerk                                   | 0.0                  |                      |
| Circular interpolation error tolerance | 100.0                |                      |

## ■Axes

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |
| 2        | Axis0002   | AXIS_REF  | Axis 2  |

## ■Axes group

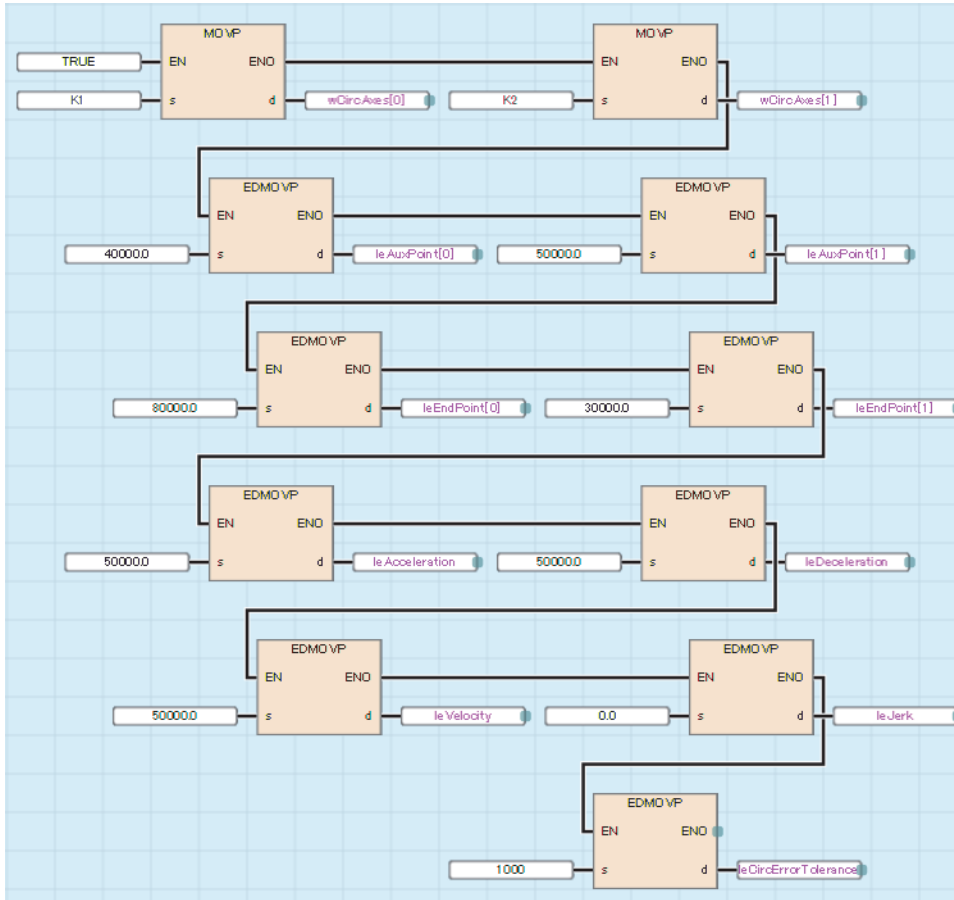
| Axes group No. | Label name   | Data type      | Comment      |
|----------------|--------------|----------------|--------------|
| 1              | AxesGroup001 | AXES_GROUP_REF | Axes group 1 |

## ■Labels used

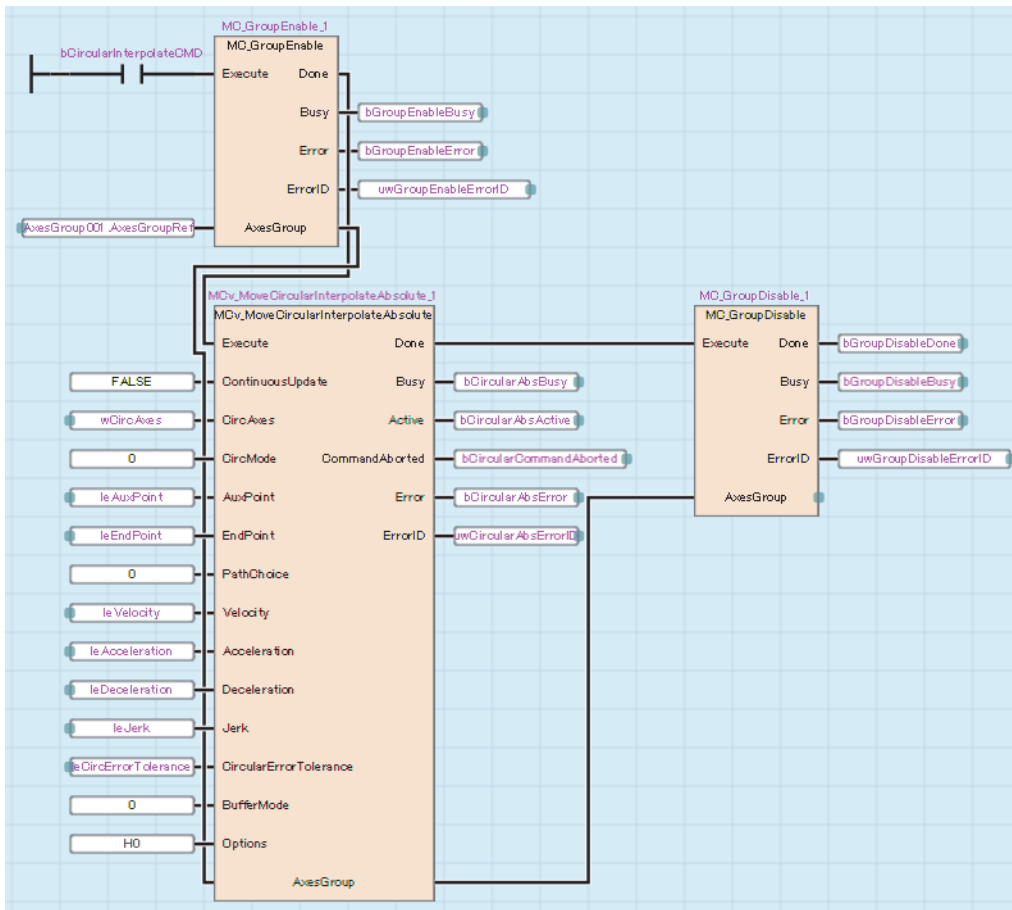
| Label name                            | Data type                           | Comment                                          |
|---------------------------------------|-------------------------------------|--------------------------------------------------|
| MCv_MoveCircularInterpolateAbsolute_1 | MCv_MoveCircularInterpolateAbsolute | Absolute Value Circular Interpolation Control FB |
| wCircAxes                             | Word[signed](0..1)                  | Circular interpolation axis                      |
| leAuxPoint                            | Double-precision real number(0..15) | Sub point                                        |
| leEndPoint                            | Double-precision real number(0..15) | End point                                        |
| leVelocity                            | Double-precision real number        | Velocity                                         |
| leAcceleration                        | Double-precision real number        | Acceleration                                     |
| leDeceleration                        | Double-precision real number        | Deceleration                                     |
| leJerk                                | Double-precision real number        | Jerk                                             |
| leCircErrorTolerance                  | Double-precision real number        | Circular interpolation error tolerance           |
| bCircularAbsDone                      | Bit                                 | Execution completion                             |
| bCircularAbsBusy                      | Bit                                 | Executing                                        |
| bCircularAbsActive                    | Bit                                 | Controlling                                      |
| bCircularCommandAborted               | Bit                                 | Abortion of execution                            |
| bCircularAbsError                     | Bit                                 | Error                                            |
| uwCircularAbsErrorID                  | Word [unsigned]/bit string [16-bit] | Error code                                       |
| MC_GroupEnable_1                      | MC_GroupEnable                      | Axes Group Enabled FB                            |
| bCircularInterpolateCMD               | Bit                                 | Circular interpolation control start             |
| bGroupEnableDone                      | Bit                                 | Axes Group Enabled Completion                    |
| bGroupEnableBusy                      | Bit                                 | Executing                                        |
| bGroupEnableError                     | Bit                                 | Error                                            |
| uwGroupEnableErrorID                  | Word [unsigned]/bit string [16-bit] | Error code                                       |
| MC_GroupDisable_1                     | MC_GroupDisable                     | Axes Group Disabled FB                           |
| bGroupDisableDone                     | Bit                                 | Axes Group Disabled Completion                   |
| bGroupDisableBusy                     | Bit                                 | Executing                                        |
| bGroupDisableError                    | Bit                                 | Error                                            |
| uwGroupDisableErrorID                 | Word [unsigned]/bit string [16-bit] | Error code                                       |

## ■FBD/LD program

- Data setting for 2-axis circular interpolation control



- Axes Group Enabled/Circular interpolation control (Border point specification)/Axis Group Disabled



## ■ST program

```
//-----Data setting for 2-axis circular interpolation control-----
wCircAxes[0]:= 1;
wCircAxes[1]:= 2;
leAuxPoint[0]:= 40000.0;
leAuxPoint[1]:= 50000.0;
leEndPoint[0]:= 80000.0;
leEndPoint[1]:= 30000.0;
leVelocity:= 50000.0;
leAcceleration:= 50000.0;
leDeceleration:= 50000.0;
leJerk:= 0.0;
leCircularErrorTolerance:= 100.0;

//-----Axes Group Enabled-----
MC_GroupEnable_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bCircularInterpolateCMD ,
  Done=> bGroupEnableDone ,
  Busy=> bGroupEnableBusy ,
  Error=> bGroupEnableError ,
  ErrorID=> uwGroupEnableErrorID
);

//-----Circular interpolation control (Border point specification)-----
MCv_MoveCircularInterpolateAbsolute_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bGroupEnableDone ,
  ContinuousUpdate:= FALSE ,
  CircAxes:= wCircAxes ,
  CircMode:= MC_CIRC_MODE__mcBorder ,
  AuxPoint:= leAuxPoint ,
  EndPoint:= leEndPoint ,
  PathChoice:= MC_CIRC_PATHCHOICE__mcCW ,
  Velocity:= leVelocity ,
  Acceleration:= leAcceleration ,
  Deceleration:= leDeceleration ,
  Jerk:= leJerk ,
  CircularErrorTolerance:= leCircularErrorTolerance ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= H00000000 ,
  Done=> bCircularAbsDone ,
  Busy=> bCircularAbsBusy ,
  Active=> bCircularAbsActive ,
  CommandAborted=> bCircularAbsCommandAborted ,
  Error=> bCircuAbsError ,
  ErrorID=> uwCircularAbsErrorID
);
```



```
//-----Axes Group Disabled-----  
MC_GroupDisable_1(  
  AxesGroup:= AxesGroup001.AxesGroupRef ,  
  Execute:= bCircularAbsDone ,  
  Done=> bGroupDisableDone ,  
  Busy=> bGroupDisableBusy ,  
  Error=> bGroupDisableError ,  
  ErrorID=> uwGroupDisableErrorID  
);
```

# 46.13 Relative Value Circular Interpolation Control

## MCv\_MoveCircularInterpolateRelative

This FB performs positioning with 2-axis circular interpolation using the configuration axes of the set axes group by setting the relative position from the current position at start to the end point and sub point.

| Ladder                                                                                                                                                                                                                                                                                                                                                                                                                                       | FBD/LD                                                                                                                                                                                                                                                                                                                                        | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div> MCv_MoveCircularInterpolateRelative<br/> DUT :AxesGroup ——— AxesGroup :DUT<br/> B :Execute Done :B<br/> B :ContinuousUpdate Busy :B<br/> W :CircAxes Active :B<br/> ENUM :CircMode CommandAborted :B<br/> L :AuxPoint Error :B<br/> L :EndPoint ErrorID :UW<br/> ENUM :PathChoice<br/> L :Velocity<br/> L :Acceleration<br/> L :Deceleration<br/> L :Jerk<br/> L :CircularErrorTolerance<br/> ENUM :BufferMode<br/> UD :Options </div> | <div> MCv_MoveCircularInterpolateRelative<br/> Execute Done<br/> ContinuousUpdate Busy<br/> CircAxes Active<br/> CircMode CommandAborted<br/> AuxPoint Error<br/> EndPoint ErrorID<br/> PathChoice<br/> Velocity<br/> Acceleration<br/> Deceleration<br/> Jerk<br/> CircularErrorTolerance<br/> BufferMode<br/> Options<br/> AxesGroup </div> | MCv_MoveCircularInterpolateRelative(<br>AxesGroup:= ?AXES_GROUP_REF? ,<br>Execute:= ?BOOL? ,<br>ContinuousUpdate:= ?BOOL? ,<br>CircAxes:= ?INT(0..1)? ,<br>CircMode:= ?INT? ,<br>AuxPoint:= ?LREAL(0..15)? ,<br>EndPoint:= ?LREAL(0..15)? ,<br>PathChoice:= ?INT? ,<br>Velocity:= ?LREAL? ,<br>Acceleration:= ?LREAL? ,<br>Deceleration:= ?LREAL? ,<br>Jerk:= ?LREAL? ,<br>CircularErrorTolerance:= ?LREAL? ,<br>BufferMode:= ?INT? ,<br>Options:= ?DWORD? ,<br>Done=> ?BOOL? ,<br>Busy=> ?BOOL? ,<br>Active=> ?BOOL? ,<br>CommandAborted=> ?BOOL? ,<br>Error=> ?BOOL? ,<br>ErrorID=> ?WORD?<br>); |

### Setting data

#### I/O variables

| I/O variable | Name                   | Data type      | Input    | Valid range | Default value         | Description                                                                                                                                                                                              |
|--------------|------------------------|----------------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxesGroup    | Axes group information | AXES_GROUP_REF | At start | —           | Omission not possible | An axes group is set.<br>For the variable <u>(AxesGroupName.AxesGroupRef.)</u> used, refer to the following.<br><a href="#">Page 1468</a><br><u>AxesGroupName.AxesGroupRef.</u> (Axes group information) |

#### Input variable

| Input variable   | Name              | Data type | Input    | Valid range | Default value | Description                                                                                                                                                                                                                                                                                                                                          |
|------------------|-------------------|-----------|----------|-------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute          | Start             | BOOL      | At start | TRUE, FALSE | FALSE         | When this variable is set to TRUE, MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control) is executed.                                                                                                                                                                                                                  |
| ContinuousUpdate | Continuous update | BOOL      | At start | TRUE, FALSE | FALSE         | Whether to enable or disable continuous change of Velocity (Velocity), Acceleration (Acceleration), and Deceleration (Deceleration) is set.<br>Continuous update re-imports input variables to the instance in execution without aborting the operation.<br><ul style="list-style-type: none"> <li>FALSE: Disabled</li> <li>TRUE: Enabled</li> </ul> |

| Input variable | Name                        | Data type                | Input    | Valid range                                                                                                                                                                                                                              | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------|-----------------------------|--------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CircAxes       | Circular interpolation axis | INT[0..1]                | At start | 1 to 16                                                                                                                                                                                                                                  | 0             | The axes to be used in circular interpolation control are set from the configuration axes. Specify the index No. (1 to 16) of the configuration axes in the array. The first element of the array is regarded as the reference axis.<br>For details, refer to the following.<br> Page 1780 Circular interpolation axis (CircAxes)                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| CircMode       | Circular interpolation mode | INT (MC_CIRC_MODE)       | At start | 0 to 2                                                                                                                                                                                                                                   | 0             | The circular interpolation specification method is set.<br><ul style="list-style-type: none"> <li>• 0: Border point specification (mcBorder)</li> <li>• 1: Center point specification (mcCenter)</li> <li>• 2: Radius specification (mcRadius)</li> </ul> For details, refer to the following.<br> Page 1780 Circular interpolation mode (CircMode)                                                                                                                                                                                                                                                                                                                                                                                                                              |
| AuxPoint       | Sub point                   | LREAL[0..15]             | At start | <p>■When "0: Border point specification (mcBorder)" or "1: Center point specification (mcCenter)" is set:<br/>-10000000000.0 to 10000000000.0</p> <p>■When "2: Radius specification (mcRadius)" is set:<br/>0.000001 to 2147483647.0</p> | 0.0           | The relative position of the sub point (border point, center point, and radius) from the start position is set.<br>The value is set as one-dimensional array data. The set value differs depending on the setting of Circular interpolation mode (CircMode).<br><p>■When "0: Border point specification (mcBorder)" or "1: Center point specification (mcCenter)" is set:<br/>The data is treated as the relative position for configuration axes 1 to 16. The absolute positions of the border point and center point are set.</p> <p>■When "2: Radius specification (mcRadius)" is set:<br/>The first element is treated as the radius and the second and subsequent elements are ignored.<br/>For details, refer to the following.<br/>  Page 1781 Sub point (AuxPoint)</p> |
| EndPoint       | End point                   | LREAL[0..15]             | At start | -10000000000.0 to 10000000000.0                                                                                                                                                                                                          | 0.0           | The movement amount from the current position at start to the end point is set.<br>The value is set as one-dimensional array data. The data is treated as the absolute position for configuration axes 1 to 16.<br>For details, refer to the following.<br> Page 1781 End point (EndPoint)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| PathChoice     | Path selection              | INT (MC_CIRC_PATHCHOICE) | At start | 0 to 5                                                                                                                                                                                                                                   | 0             | The rotation direction of the circular interpolation is set.<br><ul style="list-style-type: none"> <li>• 0: CW (mcCW)</li> <li>• 1: CCW (mcCCW)</li> <li>• 2: Shortcut (mcShortWay)</li> <li>• 3: Detour (mcLongWay)</li> <li>• 4: CW Detour (mcCWLongWay)</li> <li>• 5: CCW Detour (mcCCWLongWay)</li> </ul> <p>* When Circular interpolation mode (CircMode) is set to "0: Border point specification (mcBorder)", the input is ignored.</p> <p>* When Circular interpolation mode (CircMode) is set to "2: Radius specification (mcRadius)", "0: CW (mcCW)" means the CW shortcut and "1: CCW (mcCCW)" means the CCW shortcut.<br/>For details, refer to the following.<br/>  Page 1782 Path selection (PathChoice)</p>                                                     |

| Input variable          | Name                                   | Data type               | Input                                                                   | Valid range                    | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------|----------------------------------------|-------------------------|-------------------------------------------------------------------------|--------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Velocity                | Velocity                               | LREAL                   | At start/<br>Retrigger<br>possible/<br>Continuous<br>update<br>possible | 0.0, 0.0001 to 2500000000.0    | 0.0           | The speed command value is set.<br>For details, refer to the following.<br> Page 1783 Velocity (Velocity)                                                                                                                                                                                                                                                                                                       |
| Acceleration            | Acceleration                           | LREAL                   | At start/<br>Retrigger<br>possible/<br>Continuous<br>update<br>possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The acceleration is set.<br>For details, refer to the following.<br> Page 1783 Acceleration (Acceleration)                                                                                                                                                                                                                                                                                                      |
| Deceleration            | Deceleration                           | LREAL                   | At start/<br>Retrigger<br>possible/<br>Continuous<br>update<br>possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The deceleration is set.<br>For details, refer to the following.<br> Page 1784 Deceleration (Deceleration)                                                                                                                                                                                                                                                                                                      |
| Jerk                    | Jerk                                   | LREAL                   | At start                                                                | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The jerk is set.<br>For details, refer to the following.<br> Page 1784 Jerk (Jerk)                                                                                                                                                                                                                                                                                                                              |
| CircularError Tolerance | Circular interpolation error tolerance | LREAL                   | At start                                                                | 0.000001 to 100000.0           | 100.0         | The allowable range of circular interpolation errors is set.<br>For details, refer to the following.<br> Page 1784 Circular interpolation error tolerance (CircularErrorTolerance)                                                                                                                                                                                                                              |
| BufferMode              | Buffer mode                            | INT<br>(MC_BUFFER_MODE) | At start                                                                | 0 to 5                         | 0             | The buffer mode is set.<br><ul style="list-style-type: none"> <li>• 0: Aborting (mcAborting)</li> <li>• 1: Buffered (mcBuffered)</li> <li>• 2: BlendingLow (mcBlendingLow)</li> <li>• 3: BlendingPrevious (mcBlendingPrevious)</li> <li>• 4: BlendingNext (mcBlendingNext)</li> <li>• 5: BlendingHigh (mcBlendingHigh)</li> </ul> For details, refer to the following.<br> Page 1785 Buffer mode (BufferMode) |
| Options                 | Options                                | DWORD(HEX)              | At start                                                                | 00000000H to 00000005H         | 00000000H     | The function options for MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control) are set in the specified bit position.<br>For details, refer to the following.<br> Page 1786 Options (Options)                                                                                                                                                                                   |

## Output variables

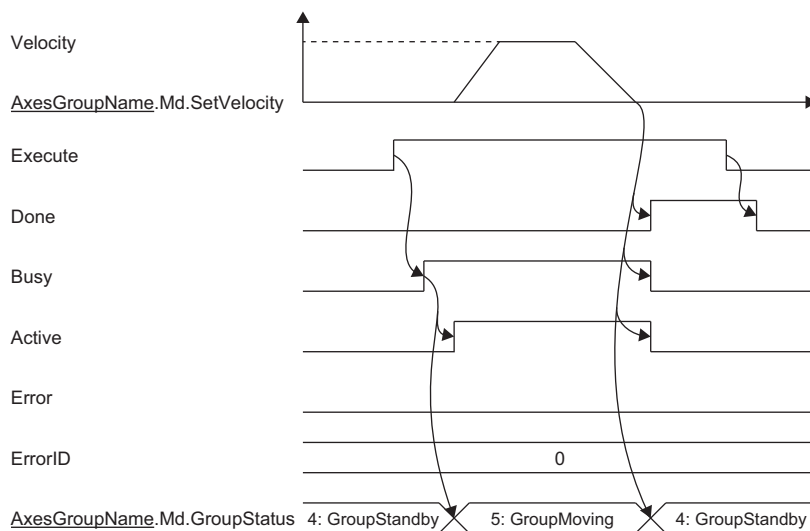
| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------|-----------------------|------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Completion            | BOOL       | FALSE         | This variable becomes TRUE when the control is completed.<br>The value differs depending on the status of Start (Execute) at operation completion.<br>■When Start (Execute) is TRUE<br>This variable remains TRUE until Start (Execute) is set to FALSE.<br>■When Start (Execute) is FALSE<br>This variable becomes TRUE only for one cycle.                                                                                       |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control) is executed.                                                                                                                                                                                                                                                                                                   |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control) is controlling the axis.<br>When multiple MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control) FBs are executed for the same axes group, Controlling (Active) of only one MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control) FB becomes TRUE. |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control) is aborted because of an error or multiple start.                                                                                                                                                                                                                                                 |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                                                                                                   |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br>User's manual for the controller used                                                                                                                                                                                                                                                                        |

## Processing details

- This FB specifies an axes group and performs interpolation control mechanically so that the path from the start point (move start point) to the end point forms an arc for a linear axis which is orthogonally arranged.
- In circular interpolation control, interpolation control is performed using two arbitrary axes from the configuration axes set to the axes group.
- For circular interpolation control, the border point specification, center point specification, and radius specification circular interpolation methods are settable.
- In MCv\_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control), 2-axis circular interpolation control is performed by specifying the movement amount from the current position to the end point or sub point.

## Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■Circular interpolation axis (CircAxes)

In circular interpolation control, circular interpolation is performed by using two arbitrary axes from the configuration axes set to the axes group.

The axes used to perform circular interpolation are specified from the configuration axes in the axes group by using Circular interpolation axis (CircAxes). The Circular interpolation axis (CircAxes) has two array elements. For the arrays, specify the index Nos. (1 to 16: configuration axis 1 to 16) of configuration axes to be used for interpolation control.

The first element of the array is regarded as the reference axis.

If the configuration axis specified does not have an axis set, Circular Interpolation Axis Unset (error code: 1ACAH) occurs.

### Ex.

When setting configuration axes 2 and 3 as the circular interpolation axes

```
CircAxes[0]:= 2;
```

```
CircAxes[1]:= 3;
```

## ■Circular interpolation mode (CircMode)

Sets the circular interpolation method (border point specification, center point specification, or radius specification) used to perform circular interpolation control.

The contents set in Sub point (AuxPoint) differ depending on the setting of Circular interpolation mode (CircMode).

| Setting value                               | Sub point (AuxPoint)                                                                                                                                                                                                                                                                 |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Border point specification<br>(mcBorder) | Sub point (AuxPoint) sets the border point on the arc connecting the start point and the end point.<br>Positioning control with arc path that passes through the specified border point is performed using the two configuration axes set in Circular interpolation axis (CircAxes). |
| 1: Center point specification<br>(mcCenter) | Sub point (AuxPoint) sets the center point of the arc.<br>Positioning control with an arc path having the center point at its center is performed using the two configuration axes set in Circular interpolation axis (CircAxes).                                                    |
| 2: Radius specification<br>(mcRadius)       | Sub point (AuxPoint) sets the radius of the arc.<br>Positioning control with an arc path having the specified radius is performed using the two configuration axes set in Circular interpolation axis (CircAxes).                                                                    |

For the operation of each circular interpolation control set in Circular interpolation mode (CircMode), refer to the following.

 User's manual for the controller used

## ■Sub point (AuxPoint)

Sets the position of the sub point (border point, center point, or radius) used to perform circular interpolation.

Sub point (AuxPoint) has 16 array elements. The contents set in Sub point (AuxPoint) differ depending on the setting of Circular interpolation mode (CircMode).

| Circular interpolation mode (CircMode)   | Setting range                   | Sub point (AuxPoint) setting                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Border point specification (mcBorder) | -10000000000.0 to 10000000000.0 | Sub point (AuxPoint) sets the border point on the arc connecting the start point and the end point.<br>AuxPoint[0..15] indicates the sub point position of configuration axis 1 to 16.<br><ul style="list-style-type: none"> <li>Sub point (AuxPoint) of configuration axes not set to the circular interpolation axes is ignored.</li> <li>Sub point (AuxPoint) of axes after all configuration axes set to the circular interpolation axes can be omitted.</li> </ul> |
| 1: Center point specification (mcCenter) |                                 | Sub point (AuxPoint) sets the center point of the arc.<br>AuxPoint[0..15] indicates the sub point position of configuration axis 1 to 16.<br><ul style="list-style-type: none"> <li>Sub point (AuxPoint) of configuration axes not set to the circular interpolation axes is ignored.</li> <li>Sub point (AuxPoint) of axes after all configuration axes set to the circular interpolation axes can be omitted.</li> </ul>                                              |
| 2: Radius specification (mcRadius)       | 0.000001 to 2147483647.0        | Sub point (AuxPoint) sets the radius of the arc.<br>AuxPoint[0] indicates the radius of the circle.<br><ul style="list-style-type: none"> <li>Inputs after AuxPoint[1] are ignored and can be omitted.</li> </ul>                                                                                                                                                                                                                                                       |

### Ex.

When setting configuration axis 2 and 3 to the circular interpolation axes and setting the relative position of the sub point for configuration axis 2 and 3 as 2000.0 and 3000.0

```
CircAxes[0]:= 2;
CircAxes[1]:= 3;
AuxPoint[0]:= 0.0;
AuxPoint[1]:= 2000.0;
AuxPoint[2]:= 3000.0;
AuxPoint[3]:= 0.0; *1
⋮
AuxPoint[15]:= 0.0; *1
```

\*1 "AuxPoint[3]:= 0.0; to AuxPoint[15]:= 0.0;" can be omitted.

## ■End point (EndPoint)

Sets the movement amount from the current position at start to the end point.

End point (EndPoint) has 16 array elements. EndPoint[0..15] indicates the end point position of configuration axis 1 to 16.

- End point (EndPoint) for configuration axes which are not set to the circular interpolation axis are ignored.
- End point (EndPoint) after all of the configuration axes which are set to the circular interpolation axis can be omitted.

## ■Path selection (PathChoice)

Sets the rotation direction for circular interpolation. For the rotation direction, the first element of the array set in Circular interpolation axis (CircAxes) is regarded as the reference axis. Path selection (PathChoice) is set when Circular interpolation mode (CircMode) is set to "1: Center point specification (mcCenter)" or "2: Radius specification (mcRadius)". When "0: Border point specification (mcBorder)" is set, this input is omitted.

The following shows the setting value, setting description, arc center angle that can be controlled, and path of Path selection (PathChoice) according to the setting of Circular interpolation mode (CircMode).

- Path for "1: Center point specification (mcCenter)"

| Setting value            | Setting description                                                                                                                                                                                                                                                                                                     | Arc center angle that can be controlled | Path |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------|
| 0: CW (mcCW)             | CW                                                                                                                                                                                                                                                                                                                      | $0^\circ < \theta \leq 360^\circ$       |      |
| 1: CCW (mcCCW)           | CCW                                                                                                                                                                                                                                                                                                                     | $0^\circ < \theta \leq 360^\circ$       |      |
| 2: Shortcut (mcShortWay) | Shortcut <ul style="list-style-type: none"> <li>• When the start point, center point, and end point are on one straight line, becomes CW. (A semicircle is drawn in the CW direction.)</li> <li>• If the start point is the same as the end point, Path Choice Setting Incorrect (error code: 1B06H) occurs.</li> </ul> | $0^\circ < \theta \leq 180^\circ$       |      |
| 3: Detour (mcLongWay)    | Detour <ul style="list-style-type: none"> <li>• When the start point, center point, and end point are on one straight line, becomes CW. (A semicircle is drawn in the CW direction.)</li> <li>• When the start point is same as the end point, becomes CW. (A perfect circle is drawn in CW direction.)</li> </ul>      | $180^\circ \leq \theta \leq 360^\circ$  |      |



• Path for "2: Radius specification (mcRadius)"

| Setting value                | Setting description                                                                                                                          | Arc center angle that can be controlled | Path |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------|
| 0: CW (mcCW)                 | CW<br>• If the start point, center point, and end point are on one straight line, Path Choice Setting Incorrect (error code: 1B06H) occurs.  | $0^\circ < \theta < 180^\circ$          |      |
| 1: CCW (mcCCW)               | CCW<br>• If the start point, center point, and end point are on one straight line, Path Choice Setting Incorrect (error code: 1B06H) occurs. | $0^\circ < \theta < 180^\circ$          |      |
| 4: CW Detour (mcCWLongWay)   | CW detour<br>• When the start point, end point, and center point are on one straight line, a semicircle is drawn.                            | $180^\circ \leq \theta < 360^\circ$     |      |
| 5: CCW Detour (mcCCWLongWay) | CCW detour<br>• When the start point, end point, and center point are on one straight line, a semicircle is drawn.                           | $180^\circ \leq \theta < 360^\circ$     |      |

## ■Velocity (Velocity)

Sets the maximum speed of the path used in MCv\_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control).

| Setting range                                |
|----------------------------------------------|
| 0.0, 0.0001 to 2500000000.0 <sup>*1</sup> *2 |

- \*1 To perform floating-point operation, the lower limit value of the command velocity is limited by the following restrictions.  
If the velocity converted from the command velocity to operation cycle is less than 0.00001, Out of Operation Cycle Converted Velocity Range (error code: 1B16H) (when changing the velocity, Out of Operation Cycle Converted Velocity Range Warning (event code: 00D2FH)) occurs. To improve the precision of floating-point operation, change Position command unit (AxisName.Pr.Unit\_Position) and Speed command unit (AxisName.Pr.Unit\_Velocity) and perform settings so that the velocity converted into the operation cycle is not less than "0.00001".
- \*2 When a Motion control FB with a commanded velocity of "0.0" performs a multiple start, the commanded velocity of the previous Motion control FB is used.

## ■Acceleration (Acceleration)

Sets the acceleration used in MCv\_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control).

The setting range differs depending on the setting for Acceleration/deceleration method setting (Options (Options): Bit 0 to 2).

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | 0.000000 <sup>*1</sup> , positive numbers from 0.000001 to 8400.0[s]                   |

- \*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Deceleration (Deceleration)

Sets the deceleration used in MCv\_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control).

Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Deceleration (Deceleration) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                                          |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                               |

\*1 The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Jerk (Jerk)

Sets the jerk used in MCv\_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control).

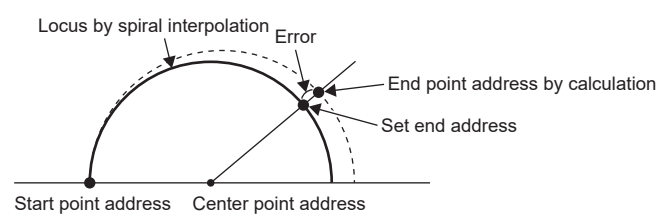
Specifies the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) is set to "0: Acceleration/deceleration specification method (mcAccDec)". Jerk (Jerk) is not used if the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".

| Acceleration/deceleration method setting (Options (Options): Bit 0 to 2) | Setting range                                                           |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec)             | 0.0000, positive numbers from 0.0001 to 2147483647.0[U/s <sup>2</sup> ] |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime)             | Not used                                                                |

## ■Circular interpolation error tolerance (CircularErrorTolerance)

In circular interpolation control with center point specification, the arc path calculated from the start position and center position may deviate from the end position set in End point (EndPoint).

Circular interpolation error tolerance (CircularErrorTolerance) sets the allowable width of errors between the calculated arc path and the end position.

| Setting range                                                                      | Description                                                                                                                                                                                                                               |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculated error ≤ Circular interpolation error tolerance (CircularErrorTolerance) | <p>Circular interpolation control to the set end point address is performed while the error compensation is carried out by spiral interpolation.</p>  |
| Calculated error > Circular interpolation error tolerance (CircularErrorTolerance) | <p>At the positioning start, Circular Interpolation Error Allowable Value Over (error code: 1AD9H) occurs and the control will not start. The operation will immediately stop if the error is detected during positioning control.</p>    |

## ■ Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following buffer modes are settable in MCv\_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control).

| Setting value                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting)                 | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                                                                                                                                                                                                                          |
| 1: Buffered (mcBuffered)                 | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB.                                                                                                                                                                                                    |
| 2: BlendingLow (mcBlendingLow)           | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the lower target velocity between the under-control FB and the buffering FB is used as the switching speed.  |
| 3: BlendingPrevious (mcBlendingPrevious) | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the under-control FB is used as the switching speed.                                  |
| 4: BlendingNext (mcBlendingNext)         | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the buffering FB is used as the switching speed.                                      |
| 5: BlendingHigh (mcBlendingHigh)         | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the higher target velocity between the under-control FB and the buffering FB is used as the switching speed. |

\*<sup>1</sup> Stops are not performed between the under-control FB and the buffering FB.

### Point

For details on multiple start (buffer mode), refer to the following.

 User's manual for the controller used

■Options (Options)

The function options for MCv\_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



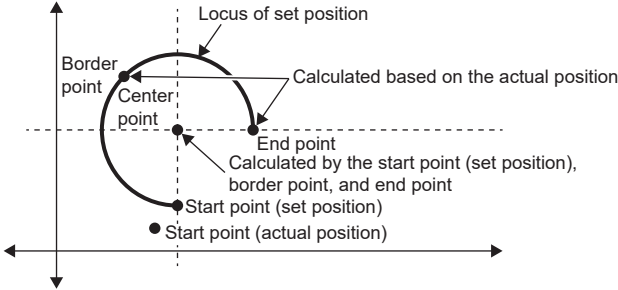
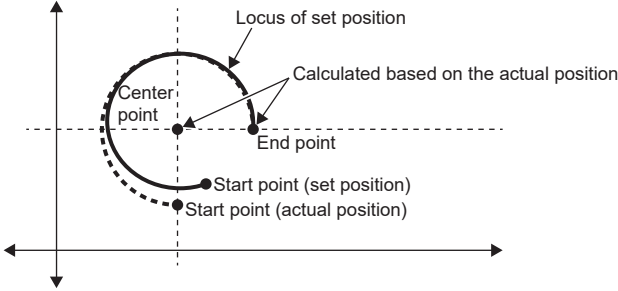
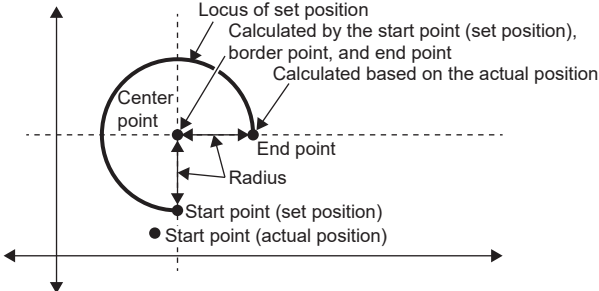
\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit    | Name                                            | Description                                                                                                                                                                                                               |
|--------|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 2 | Acceleration/<br>deceleration method<br>setting | Sets the acceleration/deceleration method used to perform control.<br>• 0: Acceleration/deceleration specification method (mcAccDec)<br>• 1: Acceleration/deceleration time-fixed method (mcFixedTime)                    |
| 3      | Position selection during<br>buffer mode        | Sets the position when executing relative positioning control by multiple start.<br>• 0: Set position<br>• 1: Actual position<br>* This bit is valid when setting "0: Aborting (mcAborting)" in Buffer mode (BufferMode). |

• Acceleration/deceleration method setting (Bit 0 to 2)

| Setting value                                                   | Description                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration<br>specification method (mcAccDec) | An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) set in MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control).                                                                                                                      |
| 1: Acceleration/deceleration time-fixed<br>method (mcFixedTime) | An acceleration/deceleration method using the acceleration/deceleration time specified in MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control) regardless of the velocity. The acceleration/deceleration time does not use Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). |

- Position selection during buffer mode (Bit 3)

| Setting value      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Set position    | Performs relative positioning control from the set position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 1: Actual position | <p>Performs relative positioning control from the actual position. The sub point (border point, center point, and radius) and end point are calculated based on the actual position, and the set position is used as the start point.</p> <p>The operation for each type of Circular interpolation mode (CircMode) is shown below.</p> <p>■When "0: Border point specification (mcBorder)" is set</p> <p>The border point and end point is calculated based on the actual position. The center point is determined by the start point (set position), border point, and end point.</p>  <p>■When "1: Center point specification (mcCenter)" is set</p> <p>The center point and end point are calculated based on the actual position. The arc of the circle may be an elliptic circle in some cases.</p>  <p>■When "2: Radius specification (mcRadius)" is set</p> <p>The end point is calculated based on the actual position. The center point is determined by the start point (set position), radius, and end point.</p>  |

### ■Necessary object data

When using MCv\_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control), set the following object data for all configuration axes in the specified axes group.

- Target position (607AH)

If there is a configuration axis where object data is not set, Necessary Slave Object Unset (error code: 1AF7H) occurs and the axis will not start.

For details on object data settings, refer to the following.

 User's manual for the controller used

## Precautions

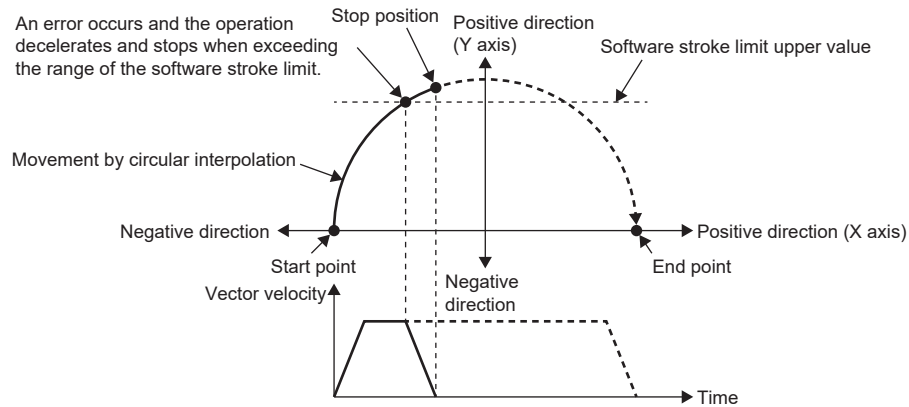
- Circular interpolation including an axis whose stroke limit is set to invalid cannot be performed. Software stroke limit invalid at circular interpolation (error code: 1ADAH) occurs and the operation does not start.
- When the interpolation path exceeds the stroke limit range during interpolation operation, Software stroke limit over (forward direction) (error code: 1A83H) or Software stroke limit over (reverse direction) (error code: 1A84H) occurs and the operation will stop.

### Ex.

When the upper limit of the software stroke limit is exceeded in the positive direction of the Y-axis

For an immediate stop, stops at the same time that the error occurs.

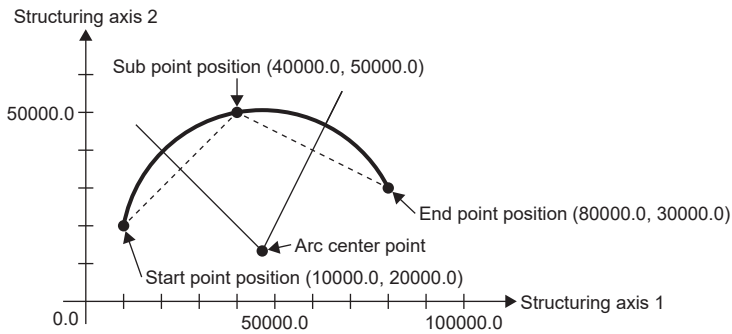
For a deceleration stop, decelerates to a stop along the arc of the circle as shown below.



## Program example

The following is a program example. The circular interpolation control start (bCircularInterpolateCMD) is set to TRUE, and Axes group 1 (AxesGroup001) is enabled. Then, 2-axis circular interpolation (sub point specification) relative positioning control is performed for Axis group 1 (AxesGroup001).

### • Operation



### • Axes group

| Item                  | Setting value |
|-----------------------|---------------|
| Configuration axis[1] | Axis0001      |
| Configuration axis[2] | Axis0002      |

### • Setting

| Item                                   | Setting value        |                      |
|----------------------------------------|----------------------|----------------------|
|                                        | Configuration axis 1 | Configuration axis 2 |
| Sub point                              | 30000.0              | 30000.0              |
| End point                              | 70000.0              | 10000.0              |
| Velocity                               | 50000.0              |                      |
| Acceleration                           | 50000.0              |                      |
| Deceleration                           | 50000.0              |                      |
| Jerk                                   | 0.0                  |                      |
| Circular interpolation error tolerance | 100.0                |                      |

## ■Axes

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |
| 2        | Axis0002   | AXIS_REF  | Axis 2  |

## ■Axes group

| Axes group No. | Label name   | Data type      | Comment      |
|----------------|--------------|----------------|--------------|
| 1              | AxesGroup001 | AXES_GROUP_REF | Axes group 1 |

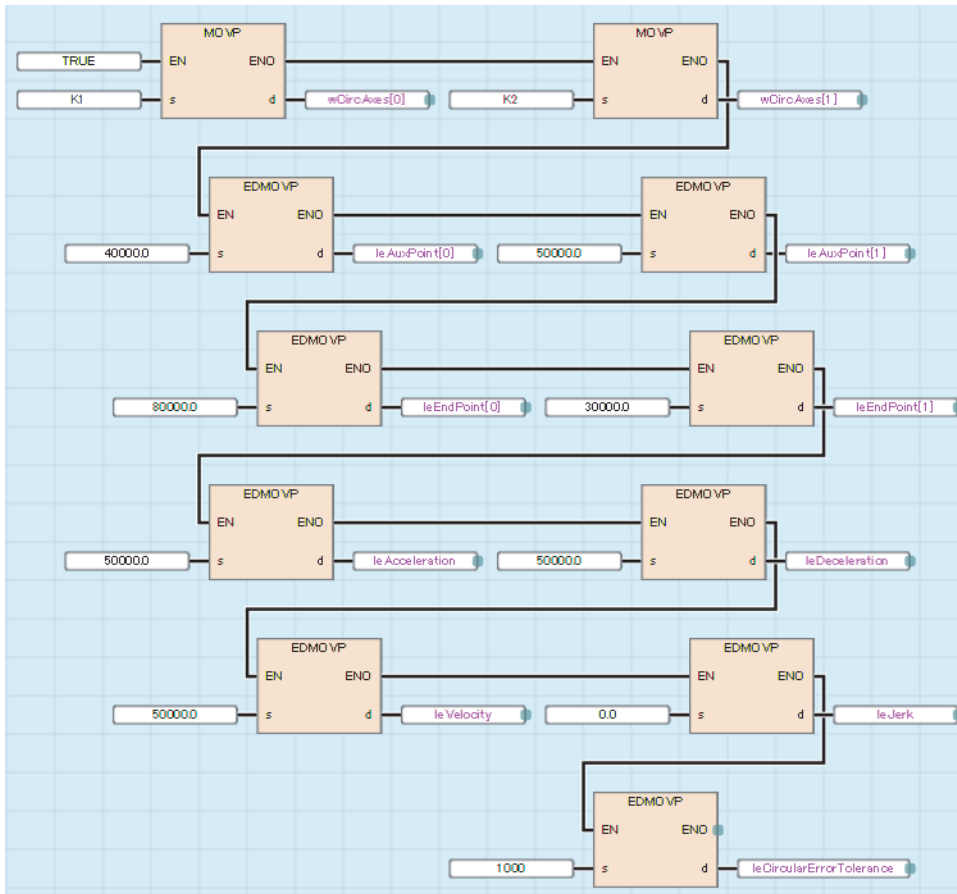
## ■Labels used

| Label name                            | Data type                           | Comment                                          |
|---------------------------------------|-------------------------------------|--------------------------------------------------|
| MCv_MoveCircularInterpolateRelative_1 | MCv_MoveCircularInterpolateRelative | Relative Value Circular Interpolation Control FB |
| wCircAxes                             | Word[signed](0..1)                  | Circular interpolation axis                      |
| leAuxPoint                            | Double-precision real number(0..15) | Sub point                                        |
| leEndPoint                            | Double-precision real number(0..15) | End point                                        |
| leVelocity                            | Double-precision real number        | Velocity                                         |
| leAcceleration                        | Double-precision real number        | Acceleration                                     |
| leDeceleration                        | Double-precision real number        | Deceleration                                     |
| leJerk                                | Double-precision real number        | Jerk                                             |
| leCircularErrorTolerance              | Double-precision real number        | Circular interpolation error tolerance           |
| bCircularRelDone                      | Bit                                 | Execution completion                             |
| bCircularRelBusy                      | Bit                                 | Executing                                        |
| bCircularRelActive                    | Bit                                 | Controlling                                      |
| bCircularRelCommandAborted            | Bit                                 | Abortion of execution                            |
| bCircularRelError                     | Bit                                 | Error                                            |
| uwCircularRelErrorID                  | Word [unsigned]/bit string [16-bit] | Error code                                       |
| MC_GroupEnable_1                      | MC_GroupEnable                      | Axes Group Enabled FB                            |
| bCircularInterpolateCMD               | Bit                                 | Circular interpolation control start             |
| bGroupEnableDone                      | Bit                                 | Axes Group Enabled Completion                    |
| bGroupEnableBusy                      | Bit                                 | Executing                                        |
| bGroupEnableError                     | Bit                                 | Error                                            |
| uwGroupEnableErrorID                  | Word [unsigned]/bit string [16-bit] | Error code                                       |
| MC_GroupDisable_1                     | MC_GroupDisable                     | Axes Group Disabled FB                           |
| bGroupDisableDone                     | Bit                                 | Axes Group Disabled Completion                   |
| bGroupDisableBusy                     | Bit                                 | Executing                                        |
| bGroupDisableError                    | Bit                                 | Error                                            |
| uwGroupDisableErrorID                 | Word [unsigned]/bit string [16-bit] | Error code                                       |

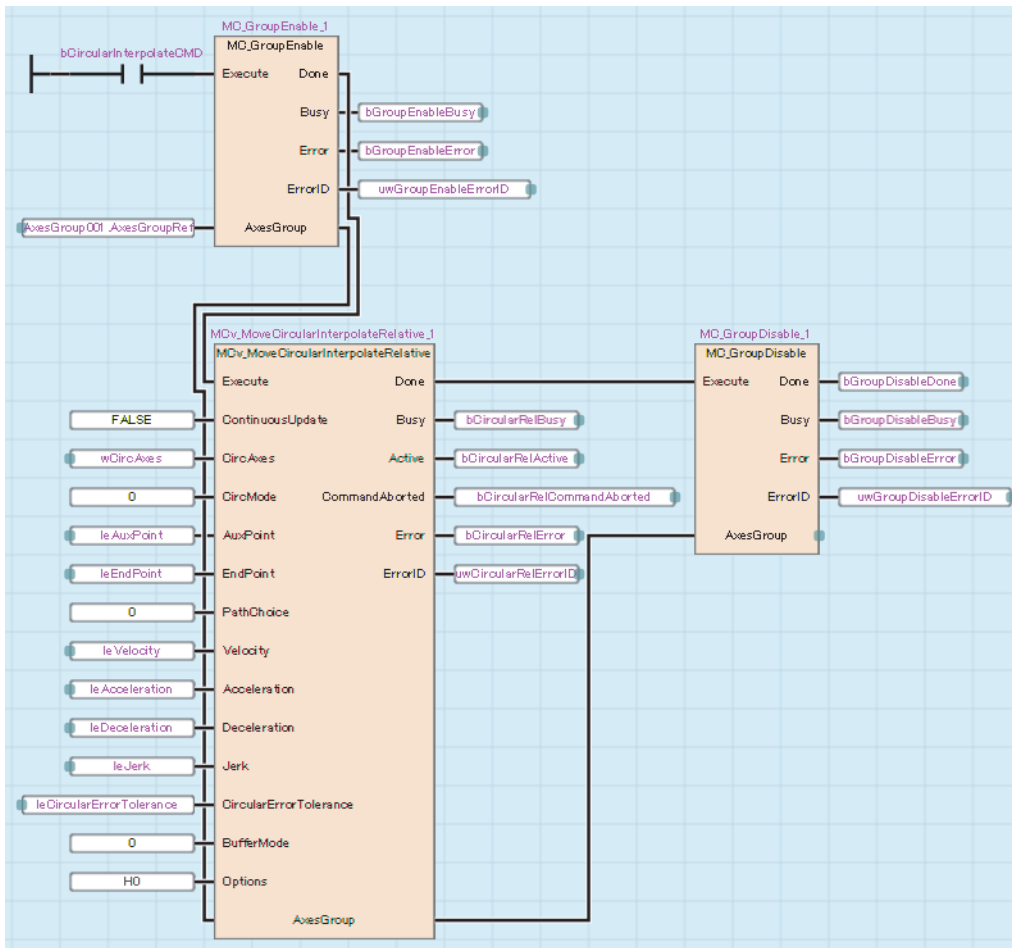


## ■FBD/LD program

- Data setting for 2-axis circular interpolation control



- Axes Group Enabled/Circular interpolation control (Border point specification)/Axis Group Disabled



## ■ST program

```
//-----Data setting for 2-axis circular interpolation control-----
wCircAxes[0]:= 1;
wCircAxes[1]:= 2;
leAuxPoint[0]:= 30000.0;
leAuxPoint[1]:= 30000.0;
leEndPoint[0]:= 70000.0;
leEndPoint[1]:= 10000.0;
leVelocity:= 50000.0;
leAcceleration:= 50000.0;
leDeceleration:= 50000.0;
leJerk:= 0.0;
leCircularErrorTolerance:= 100.0;

//-----Axes Group Enabled-----
MC_GroupEnable_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bCircularInterpolateCMD ,
  Done=> bGroupEnableDone ,
  Busy=> bGroupEnableBusy ,
  Error=> bGroupEnableError ,
  ErrorID=> uwGroupEnableErrorID
);

//-----Circular interpolation control (Border point specification)-----
MCv_MoveCircularInterpolateRelative_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
  Execute:= bGroupEnableDone ,
  ContinuousUpdate:= FALSE ,
  CircAxes:= wCircAxes ,
  CircMode:= MC_CIRC_MODE__mcBorder ,
  AuxPoint:= leAuxPoint ,
  EndPoint:= leEndPoint ,
  PathChoice:= MC_CIRC_PATHCHOICE__mcCW ,
  Velocity:= leVelocity ,
  Acceleration:= leAcceleration ,
  Deceleration:= leDeceleration ,
  Jerk:= leJerk ,
  CircularErrorTolerance:= leCircularErrorTolerance ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= H00000000 ,
  Done=> bCircularRelDone ,
  Busy=> bCircularRelBusy ,
  Active=> bCircularRelActive ,
  CommandAborted=> bCircularRelCommandAborted ,
  Error=> bCircularRelError ,
  ErrorID=> uwCircularRelErrorID
);

//-----Axes Group Disabled-----
MC_GroupDisable_1(
  AxesGroup:= AxesGroup001.AxesGroupRef ,
```

```
Execute:= bCircularRelDone ,  
Done=> bGroupDisableDone ,  
Busy=> bGroupDisableBusy ,  
Error=> bGroupDisableError ,  
ErrorID=> uwGroupDisableErrorID  
);
```

# 46.14 Cam Operation Start

46

## MC\_CamIn

This FB starts cam operation according to the specified cam data.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MC_CamIn(   Master:= ?AXIS_REF? ,   Slave:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   MasterOffset:= ?LREAL? ,   SlaveOffset:= ?LREAL? ,   MasterScaling:= ?LREAL? ,   SlaveScaling:= ?LREAL? ,   MasterStartDistance:= ?LREAL? ,   MasterSyncPosition:= ?LREAL? ,   StartMode:= ?INT? ,   MasterValueSource:= ?INT? ,   CamTableID:= ?MC_CAM_ID? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   InSync=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   EndOfProfile=&gt; ?BOOL? ); </pre> |

## Setting data

### I/O variables

| I/O variable | Name        | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|-------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Master       | Master axis | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |
| Slave        | Slave axis  | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

### Input variable

| Input variable   | Name              | Data type | Input    | Valid range | Default value | Description                                                                                                                                                                                                                                                                 |
|------------------|-------------------|-----------|----------|-------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute          | Execution command | BOOL      | At start | TRUE, FALSE | FALSE         | When this variable is set to TRUE, MC_CamIn (Cam Operation Start) is executed.                                                                                                                                                                                              |
| ContinuousUpdate | Continuous update | BOOL      | At start | TRUE, FALSE | FALSE         | Whether to enable or disable continuous change of Master axis offset (MasterOffset), Slave axis offset (SlaveOffset), Master axis scaling (MasterScaling), Slave axis scaling (SlaveScaling), and Cam table ID (CamTableID) is set.<br>• FALSE: Disabled<br>• TRUE: Enabled |

| Input variable      | Name                                       | Data type               | Input                                                          | Valid range                     | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------|--------------------------------------------|-------------------------|----------------------------------------------------------------|---------------------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MasterOffset        | Master axis offset                         | LREAL                   | At start/<br>Retrigger possible/<br>Continuous update possible | -10000000000.0 to 10000000000.0 | 0.0           | The phase of Master axis (Master) is shifted by the offset amount.<br>For details, refer to the following.<br> Page 1809 Master axis offset (MasterOffset)                                                                                                                                                                          |
| SlaveOffset         | Slave axis offset                          | LREAL                   | At start/<br>Retrigger possible/<br>Continuous update possible | -10000000000.0 to 10000000000.0 | 0.0           | The displacement of the slave axis (Slave) is shifted by the offset amount.<br>For details, refer to the following.<br> Page 1810 Slave axis offset (SlaveOffset)                                                                                                                                                                   |
| MasterScaling       | Master axis scaling                        | LREAL                   | At start/<br>Retrigger possible/<br>Continuous update possible | 0.01 to 10.0                    | 1.0           | The cam table length per cycle is expanded or reduced.<br>For details, refer to the following.<br> Page 1811 Master axis scaling (MasterScaling)                                                                                                                                                                                    |
| SlaveScaling        | Slave axis scaling                         | LREAL                   | At start/<br>Retrigger possible/<br>Continuous update possible | 0.01 to 10.0                    | 1.0           | The stroke amount of the cam table is expanded or reduced.<br>For details, refer to the following.<br> Page 1811 Slave axis scaling (SlaveScaling)                                                                                                                                                                                  |
| MasterStartDistance | Master axis follow-up distance             | LREAL                   | At start                                                       | -10000000000.0 to 10000000000.0 | 0.0           | The setting value is ignored.                                                                                                                                                                                                                                                                                                                                                                                          |
| MasterSyncPosition  | Master axis synchronization start position | LREAL                   | At start                                                       | -10000000000.0 to 10000000000.0 | 0.0           | The position of Master axis (Master) that will start synchronization by Current value per cycle (InputPerCycle) is set.<br>* If Specifying target of Master axis synchronization start position pass check (Options (Options): Bit 21) is set to "1: Master axis set position, or the feedback position", the valid range is within the ring counter range.                                                            |
| StartMode           | Start mode                                 | INT<br>(MC_START_MODE)  | At start                                                       | 0, 1                            | 0             | The timing for starting cam operation is set.<br>• 0: Immediate (mcImmediate)<br>• 1: Absolute (mcAbsolute)<br>For details, refer to the following.<br> Page 1812 Start mode (StartMode)                                                                                                                                          |
| MasterValueSource   | Master axis data source selection          | INT<br>(MC_SOURCE)      | At start                                                       | 1, 2, 101, 102                  | 1             | The data source of Master axis (Master) is set.<br>• 1: Set value (mcSetValue)<br>• 2: Actual value (mcActualValue)<br>• 101: Latest set value (mcLatestSetValue)<br>• 102: Latest actual value (mcLatestActualValue)<br>For details, refer to the following.<br> Page 1813 Master axis data source selection (MasterValueSource) |
| CamTableID          | Cam table ID                               | MC_CAM_ID               | At start/<br>Retrigger possible/<br>Continuous update possible | 1 to 60000                      | 0             | The cam ID is set.<br>Open the cam ID to the open area with MC_CamTableSelect (Cam Table Selection) before use.                                                                                                                                                                                                                                                                                                        |
| BufferMode          | Buffer mode                                | INT<br>(MC_BUFFER_MODE) | At start                                                       | 0, 1                            | 0             | The buffer mode is set.<br>• 0: Aborting (mcAborting)<br>• 1: Buffered (mcBuffered)<br>For details, refer to the following.<br> Page 1814 Buffer mode (BufferMode)                                                                                                                                                                |
| Options             | Options                                    | DWORD(H<br>EX)          | At start                                                       | 00000000H to 00210000H          | 00000000H     | The function options for MC_CamIn (Cam Operation Start) are set in the specified bit position.<br>For details, refer to the following.<br> Page 1819 Options (Options)                                                                                                                                                            |

## ■Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------|-----------------------|------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InSync          | In synchronization    | BOOL       | FALSE         | This variable becomes TRUE when Output value (OutputData) starts synchronization.                                                                                                                                                                                                                                                                                                     |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MC_CamIn (Cam Operation Start) is executed.                                                                                                                                                                                                                                                                                                           |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE when Current value per cycle (InputPerCycle) starts synchronization.                                                                                                                                                                                                                                                                                       |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_CamIn (Cam Operation Start) is aborted.<br>The variable becomes FALSE when Execution command (Execute) becomes FALSE.                                                                                                                                                                                                                 |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                                                      |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                                                                                                                         |
| EndOfProfile    | Cam cycle completion  | BOOL       | FALSE         | After Controlling (Active) becomes TRUE, this variable becomes TRUE only for one execution cycle of the POU (Program Organization Unit) that calls FB each time movement equal to the cycle length occurs.<br>For details, refer to the following.<br> Page 1819 Cam cycle completion (EndOfProfile) |

## ■Public variables

| Public variable | Name                    | Data type  | Default value | Description                                                                                                                                                                                                           |
|-----------------|-------------------------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InputPerCycle   | Current value per cycle | LREAL      | 0.0           | The current value per cycle is stored.<br>For details, refer to the following.<br> Page 1819 Current value per cycle (InputPerCycle) |
| Reference       | Reference value         | LREAL      | 0.0           | The reference value is stored.<br>For details, refer to the following.<br> Page 1820 Reference value (Reference)                   |
| OutputData      | Output value            | LREAL      | 0.0           | The output value is stored.<br>For details, refer to the following.<br> Page 1821 Output value (OutputData)                        |
| InstanceID      | Instance ID             | WORD(UINT) | 0             | The instance ID is stored.<br>This variable is automatically set by the system when an instance is created.<br>This instance ID is used in FB input, etc.                                                             |

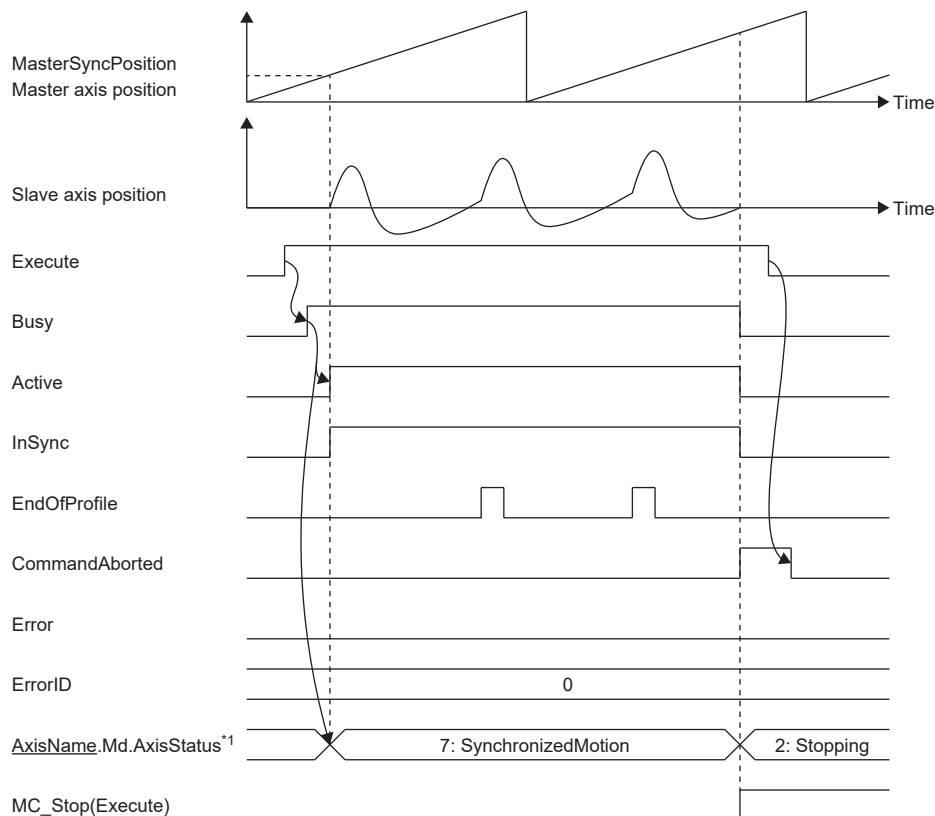
## Processing details

- This FB sets Master axis offset (MasterOffset), Slave axis offset (SlaveOffset), Master axis scaling (MasterScaling), Slave axis scaling (SlaveScaling), Master axis follow-up distance (MasterStartDistance), Master axis synchronization start position (MasterSyncPosition), Start mode (StartMode), Master axis data source selection (MasterValueSource), Cam tableID (CamTableID), and Buffer mode (BufferMode), and performs the cam operation.
- To stop the operation, perform MC\_Stop (Forced Stop).

### ■ Timing chart

- When the processing is completed successfully

When Start Mode (StartMode) is set to "1: Absolute (mcAbsolute)" and Master axis absolute coordinate (MasterAbsolute) set in MC\_CamTableSelect (Cam Table Selection) is "FALSE (Relative coordinate)"



\*1 Axis status of Slave axis (Slave)

- When the processing is completed with an error

For the timing chart, refer to the following.

☞ Page 1432 Basic operation of Execution command (Execute) type motion control FBs



## ■ Starting cam operation

By setting Start Mode (StartMode), the synchronization timing for cam operation and reflection timing for the cam control data can be set.

- Synchronization timing for cam operation

The following shows the synchronization timing for Current value per cycle (InputPerCycle), Reference value (Reference), and Output value (OutputData) based on Start mode (StartMode) and related parameters (Master axis synchronization start position (MasterSyncPosition) and Master axis follow-up distance (MasterStartDistance)).

| Start mode (StartMode)*1   | Timing for starting synchronization                                                                                                                                                                              |                             |                           |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------|
|                            | Current value per cycle (InputPerCycle)                                                                                                                                                                          | Reference value (Reference) | Output value (OutputData) |
| 0: Immediate (mclmmediate) | Synchronization starts when MC_CamIn (Cam Operation Start) is executed.<br>Master axis synchronization start position (MasterSyncPosition) and Master axis follow-up distance (MasterStartDistance) are ignored. |                             |                           |
| 1: Absolute (mcAbsolute)   | Synchronization starts when the master axis position*2 passes Master axis synchronization start position (MasterSyncPosition)*3.<br>Master axis follow-up distance (MasterStartDistance) is ignored.             |                             |                           |

\*1 For details on Start mode (StartMode), refer to the following.

📖 Page 1812 Start mode (StartMode)

\*2 Set the position data to be used based on Specifying target of Master axis synchronization start position pass check (Options (Options): Bit 21). For details, refer to the following.

📖 Page 1819 Options (Options)

\*3 The position of the Master axis has crossed over Master axis synchronization start position (MasterSyncPosition)(or, the Master axis synchronization start position (MasterSyncPosition) + Master axis follow-up distance (MasterStartDistance)). When these values are the same, the Master axis is considered to have not passed, and should the Master axis move from this value, it will be considered to have passed.

- Timing of control change by FB restart/continuous update

The following shows the timing for reflecting changed parameters in control by FB restart/continuous update based on Start mode (StartMode).

| Start mode (StartMode)     | Timing for reflecting parameters                                                      |
|----------------------------|---------------------------------------------------------------------------------------|
| 0: Immediate (mclmmediate) | Immediate                                                                             |
| 1: Absolute (mcAbsolute)   | When the current value per cycle (InputPerCycle) passes the 1st point on the CamTable |

When the changed values exceed the range, the error is output and the control is maintained by keeping the value before.

| Parameter                           | Error                                                                                                                                                                                                                                                                                  |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Master axis offset (MasterOffset)   | Out of Master axis offset range (error code: 1AAFH)                                                                                                                                                                                                                                    |
| Slave axis offset (SlaveOffset)     | Out of slave axis range (error code: 1AB0H)                                                                                                                                                                                                                                            |
| Master axis scaling (MasterScaling) | Out of master axis coefficient range (error code: 1AB1H)                                                                                                                                                                                                                               |
| Slave axis scaling (SlaveScaling)   | Out of slave axis coefficient range (error code: 1AB2H)                                                                                                                                                                                                                                |
| Cam table ID (CamTableID)           | <ul style="list-style-type: none"> <li>• When the Cam table ID (CamTableID) value is out of range</li> <li>Out of cam table ID range (error code: 1AAEH)</li> <li>• When there is no Cam table ID (CamTableID) open area</li> <li>No Cam Table warning (event code: 00D44H)</li> </ul> |

## ■Cam table information

For cam table information, the following shows the cam operation at execution of MC\_CamIn (Cam Operation Start) depending on the periodic mode, master axis absolute coordinate, and slave axis absolute coordinate set in MC\_CamTableSelect (Cam Table Selection).

○: Used in control, ×: Not used in control

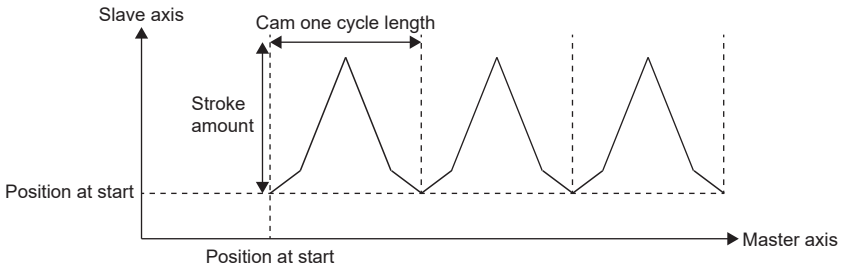
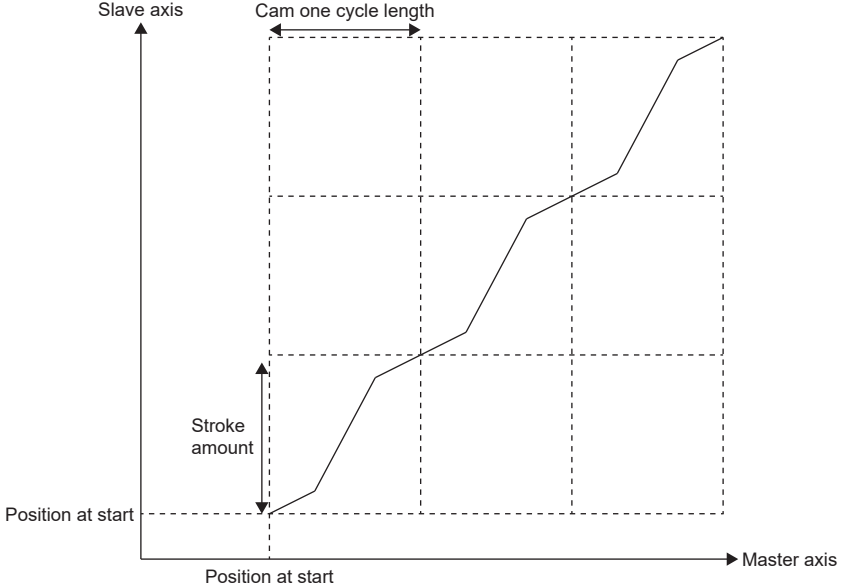
| Name                            | Variable name  | Specifying interpolation method (Interpolate) |                                |                         | Remark                                                                                                                                                                    |
|---------------------------------|----------------|-----------------------------------------------|--------------------------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 |                | 0: Linear interpolation                       | 1: Specifying for each section | 2: Spline interpolation |                                                                                                                                                                           |
| Periodic                        | Periodic       | ○                                             | ○                              | ○                       | These items can be set in the expand setting of the operation profile data using the engineering tool, or in the MC_CamTableSelect (Cam Table Selection) input variables. |
| Master axis absolute coordinate | MasterAbsolute | ○                                             | ○                              | ○                       |                                                                                                                                                                           |
| Slave axis absolute coordinate  | SlaveAbsolute  | ○                                             | ○                              | ○                       |                                                                                                                                                                           |
| Specifying interpolation method | Interpolate    | ○                                             | ○                              | ○                       | These are items related to the control of data opened to the open area from a cam data format/rotary cutter format operation profile data.                                |
| Length per cycle                | CycleLength    | ○                                             | ○                              | ○                       |                                                                                                                                                                           |
| Stroke amount                   | Stroke         | ○                                             | ○                              | ○                       |                                                                                                                                                                           |
| Start point                     | StartPoint     | ×                                             | ×                              | ×                       |                                                                                                                                                                           |
| Initial stroke amount           | StartStroke    | ×                                             | ○                              | ○                       |                                                                                                                                                                           |

- Periodic (Periodic)

The following shows the operation at execution of MC\_CamIn (Cam Operation Start) by the setting of Periodic (Periodic).

| Periodic (Periodic)  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FALSE (Non periodic) | <p>Operation is performed for one cycle only after Controlling (Active) becomes TRUE. Following this, the operation set in Specifying operation after one cycle operation (Options (Options): Bit 16) is performed.</p> <p>■When Specifying operation after one cycle operation (Options (Options): Bit 16) is set to "0: Complete" Synchronization status is cancelled after one cycle, and Reference value (Reference) and Output value (OutputData) change to "0.0 (Default value)" when Execution command (Execute) is started again.</p> |

| Periodic (Periodic)  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FALSE (Non periodic) | <p>■When Specifying operation after one cycle operation (Options (Options): Bit 16) is set to "1: Wait for restart" Synchronization status is maintained after one cycle, and Reference value (Reference) and Output value (OutputData) keep their value when Execution command (Execute) is started again.</p> <p>Input stop cause to the slave axis to cancel synchronization status.</p> <p>During a restart after one cycle has completed, even when values of input labels where continuous update is possible are changed, any input information will not be imported until Execution command (Execute) is started.</p> <p>If Execution command (Execute) is started, regardless of the Start mode (StartMode) settings, the slave axis will immediately start moving.</p> <p>While waiting for a restart after one cycle has completed, if a change to the current value per cycle is executed, this will be valid from the next cycle.</p> |

| Periodic (Periodic) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TRUE (Periodic)     | <p>Continuously repeats cam table execution. The following shows the operation based on the cam operation (two-way cam or feed cam).</p> <p>■Two-way cam<br/>When the position of Slave axis (Slave) used by Periodic for the cam table start point is the same each time, operates as a two-way cam.</p>  <p>■Feed cam<br/>When the position of Slave axis (Slave) used by Periodic for the cam table start point has a different set position at the start point and the end point, operates as a feed cam.</p>  |

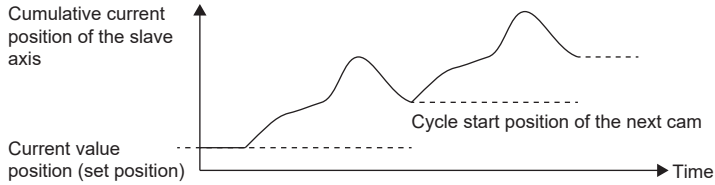
- Master axis absolute coordinate (MasterAbsolute)

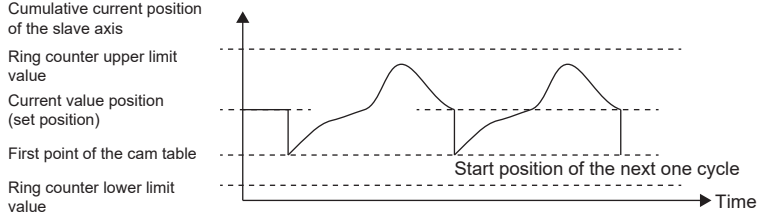
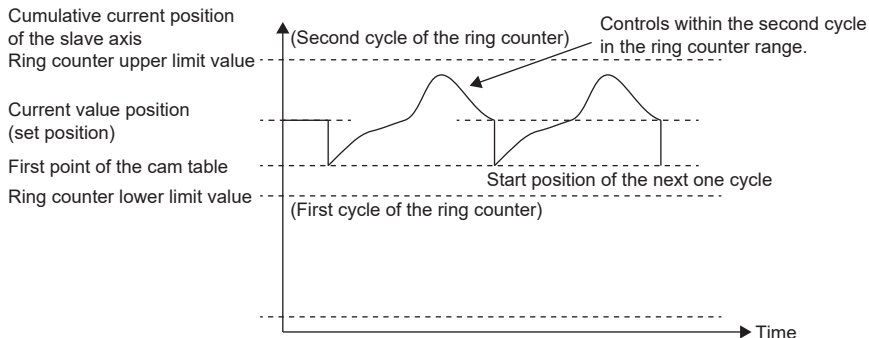
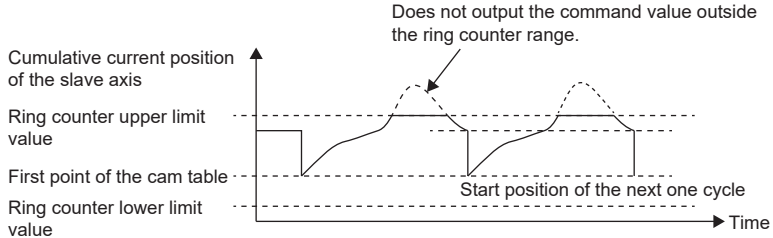
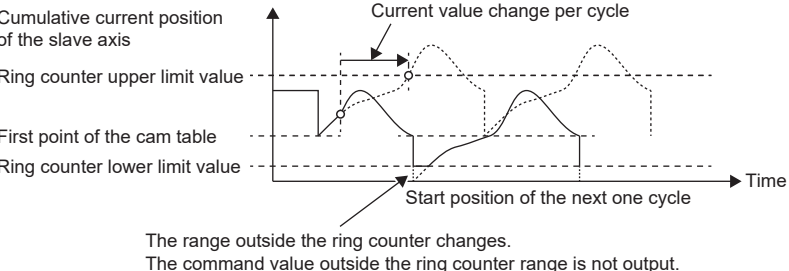
The following shows the cam operation depending on the setting of Master axis absolute coordinate (MasterAbsolute).

| Master axis absolute coordinate (MasterAbsolute) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FALSE (Relative coordinate)                      | <p>The master axis synchronization start position (MasterSyncPosition) becomes the start point of the cam data. When In synchronization (InSync) becomes TRUE, cam operation is executed corresponding to the relative movement amount of Master axis (Master).</p> <p>Cam operation is executed continuously, even when the ring counters of Master axis (Master) and the cam table are not matched.</p> <p>&lt;Example&gt;</p> <p>When the following settings are used</p> <ul style="list-style-type: none"> <li>• Master axis: Ring counter of the current value: 0.0000 to 360.0000 [degree]</li> <li>• Master axis synchronization start position (MasterSyncPosition): 180.0000 [degree]</li> <li>• Cam: Cam length per cycle: 540.0000 [degree]</li> </ul> <p>[Master axis]</p> <p>360.0000</p> <p>MasterSyncPosition(180.0000)</p> <p>0.0000</p> <p>Time</p> <p>[Slave axis]</p> <p>Current value per cycle</p> <p>560.0000</p> <p>0.0000</p> <p>Time</p> <p>When the master axis passes the position "180.0000", the slave axis starts operation. The axis operates according to the movement amount of the master axis.</p> <p>Set position</p> <p>Feed cam</p> <p>Time</p> <p>InSync</p> |

- Slave axis absolute coordinate (SlaveAbsolute)

The following shows the cam operation depending on the setting of Slave axis absolute coordinate (SlaveAbsolute).

| Slave axis absolute coordinate (SlaveAbsolute) | Description                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FALSE (Relative coordinate)                    | <p>When In synchronization (InSync) becomes TRUE, the slave axis starts the operation of the cam table from the current position (set position).</p> <p>When Periodic (Periodic) of the cam table is set to "TRUE: Periodic", the next cycle starts from the stroke position (set position) where the last cycle completed.</p>  |

| Slave axis absolute coordinate (SlaveAbsolute) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TRUE (Absolute coordinate)                     | <p>The cam is operated within the ring counter range including current values of the Slave axis (Slave) at the point when In synchronization (InSync) becomes TRUE.</p> <p>Command is output per operation cycle to return the set position of the Slave axis (Slave) to the start point of the cam table when In synchronization (InSync) and when the cam cycle completion (EndOfProfile) become TRUE. If the command at this time is too large, the position command and speed command to the drive unit also become too large, causing a servo error ("AL.035 (Command frequency error)") for the MR-J5(W)-G. The set position of the Slave axis (Slave) will not output any values outside the ring counter range.</p> <p>■When the Stroke Range is within the ring counter range of the Slave axis</p>  <p>■When the Stroke Range is within the ring counter range of the Slave axis (Cam started on the 2nd cycle)</p>  <p>■When the Stroke Range is outside the ring counter range of the Slave axis</p>  <p>■When current value per cycle is changed</p> <ul style="list-style-type: none"> <li>To compensate the Reference value (Reference) so that the Slave axis (Slave) does not operate, any range outside of the ring counter range will be changed. When the Slave axis (Slave) has moved and the current value per cycle has changed, change the Master axis offset (MasterOffset).</li> </ul>  |



- Length per cycle (CycleLength)

For the length per cycle, the input amount that is required for one cycle is set. For details, refer to the following.

☞ Page 1819 Current value per cycle (InputPerCycle)

- Stroke amount (Stroke)

For the stroke amount, the stroke amount corresponding to the stroke ratio at 100% is set. For details, refer to the following.

☞ Page 1821 Output value (OutputData)

- Start point (StartPoint) and Initial stroke amount (StartStroke)

The Start Point (StartPoint) used for cam operation and the Initial stroke amount (StartStroke) will differ depending on the Specifying interpolation method (Interpolate).

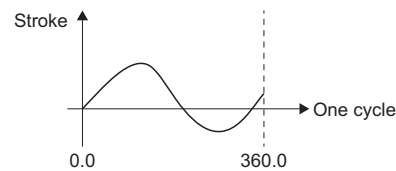
| Specifying interpolation method (Interpolate) | Cam operation Start Point                           | Cam operation initial stroke amount                  |
|-----------------------------------------------|-----------------------------------------------------|------------------------------------------------------|
| 0: Linear interpolation                       | Input value of the cam table 1st point              | Output value of the cam table 1st point              |
| 1: Specifying for each section                | Start Point (StartPoint) of the cam table 1st point | Initial stroke amount (StartStroke) of the cam table |
| 2: Spline interpolation                       |                                                     |                                                      |

#### ■ Cam operation Start Point

Operating with a Current value per cycle (InputPerCycle) of "0.0".

- Cam table

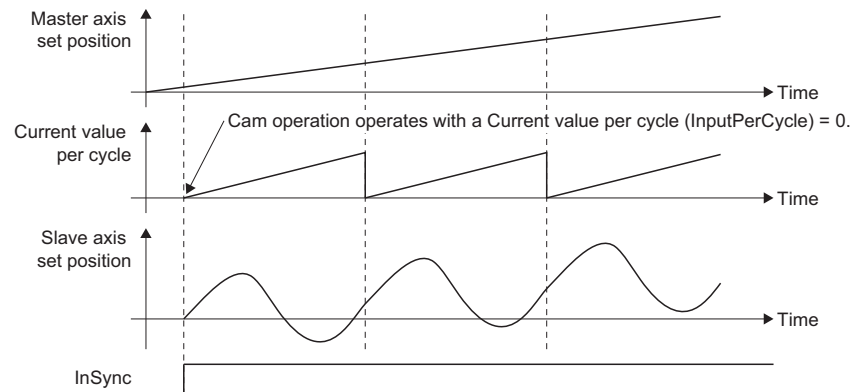
#### ■ Cam (1) (Cam operation start point "0.0")



- Interpolation method: Section interpolation
- Length per cycle: 360.0
- Start point: 0.0
- Initial stroke amount: 0.0

- Cam operation

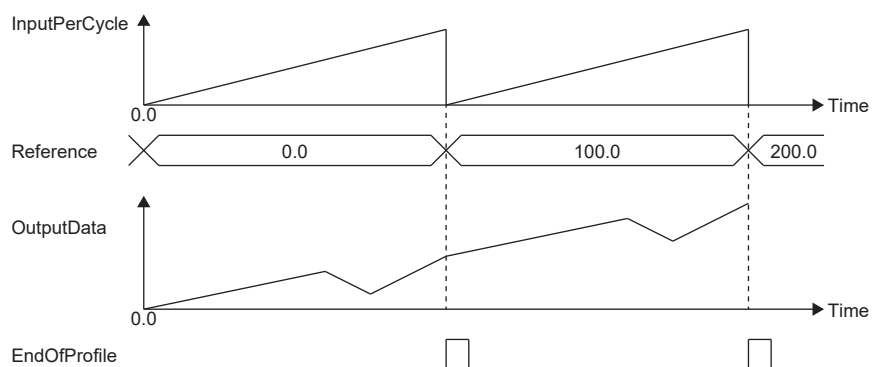
The following describes operation of the program.



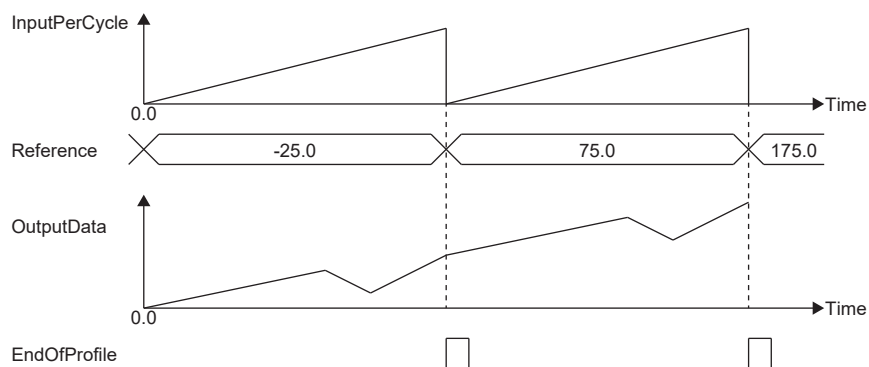
#### ■ Cam operation initial stroke amount

Operates so that the initial stroke amount equals the Output value (OutputData) at the start of synchronization. Because the initial stroke amount of the cam operation stops the Slave axis (Slave) from operating, the initial stroke amount from the reference axis (Reference) is decreased.

- When Initial stroke amount (StartStroke) of the cam operation is "0.0"



- When Initial stroke amount (StartStroke) of the cam operation is "25.0"

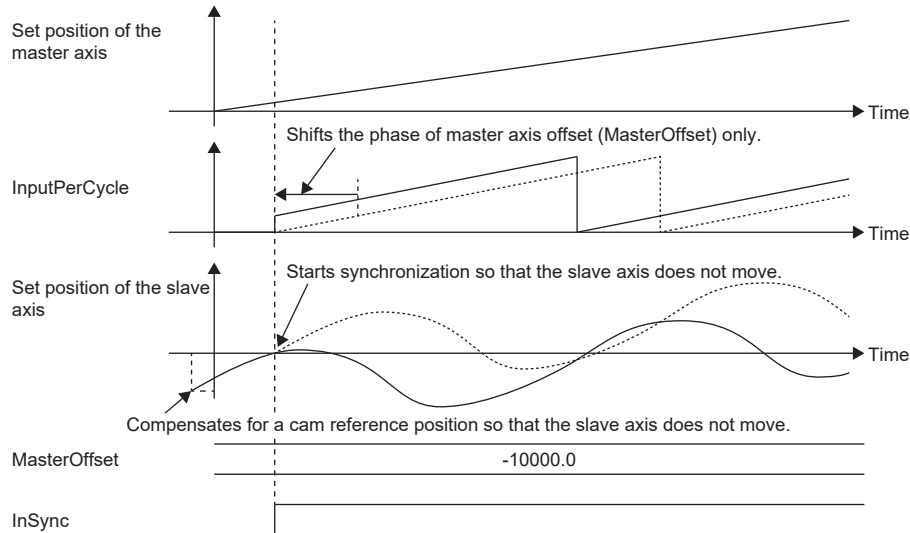


## ■ Master axis offset (MasterOffset)

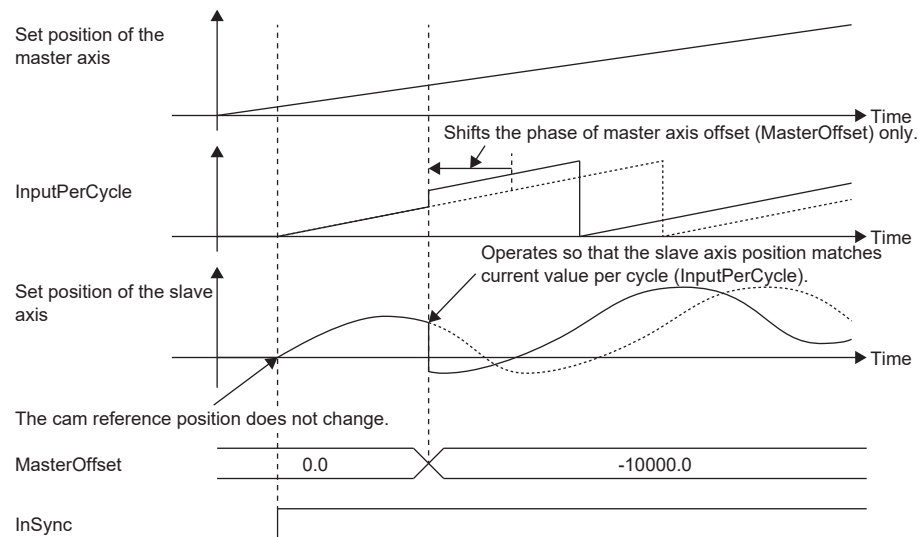
Setting Master axis offset (MasterOffset) shifts the phase of Master axis (Master) by the offset amount. (This does not affect Master axis follow-up distance (MasterStartDistance) or Master axis synchronization start position (MasterSyncPosition).)

When a value other than "0.0" is set at operation start, the position of Master axis (Master) is changed at the rising edge of In synchronization (InSync) to the cam position per cycle position with the offset amount added. When this happens, the Reference value (Reference) is compensated so that the Slave axis (Slave) does not operate.

- When Start Mode (StartMode) is "0: Immediate (mclmmediate)"



- When Start Mode (StartMode) is "0: Immediate (mclmmediate)"



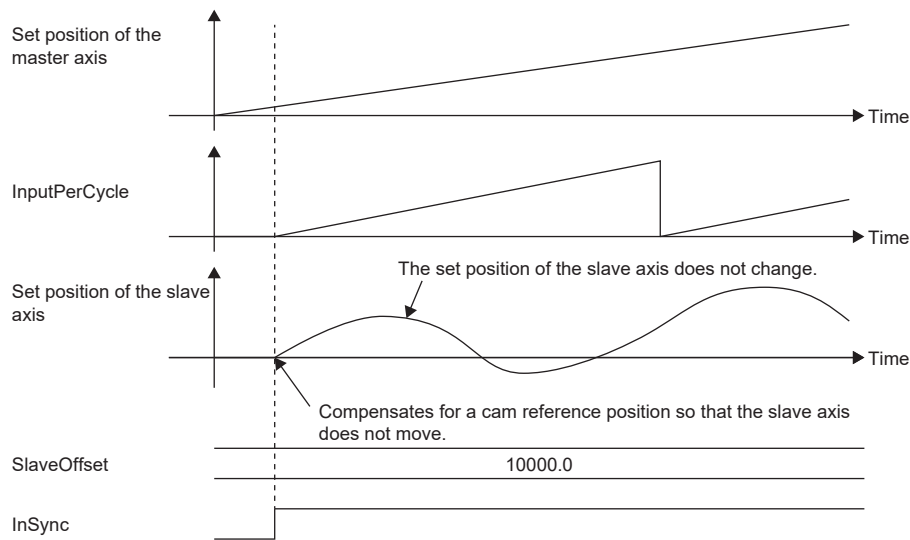
When the master axis offset (MasterOffset) is changed while In Synchronization (InSync) is TRUE, the position of the Slave axis (Slave) operates matching the current value per cycle with Master axis Offset (MasterOffset) added.

## ■ Slave axis offset (SlaveOffset)

This variable shifts the displacement of the slave axis (Slave) by the offset amount.

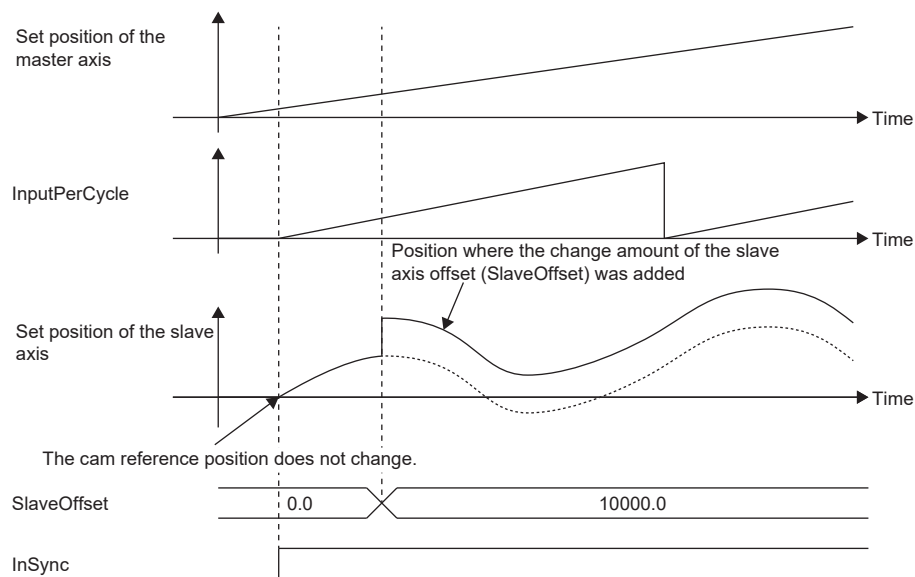
When a value other than "0.0" is set before the rising edge of In synchronization (InSync), the Reference value (Reference) is compensated so that the Slave axis (Slave) does not operate at the rising edge of In synchronization (InSync).

- When Start Mode (StartMode) is "0: Immediate (mclmmediate)"



When the slave axis offset (SlaveOffset) is changed while In Synchronization (InSync) is TRUE, the position of the Slave axis (Slave) operates matching the position with the offset amount added.

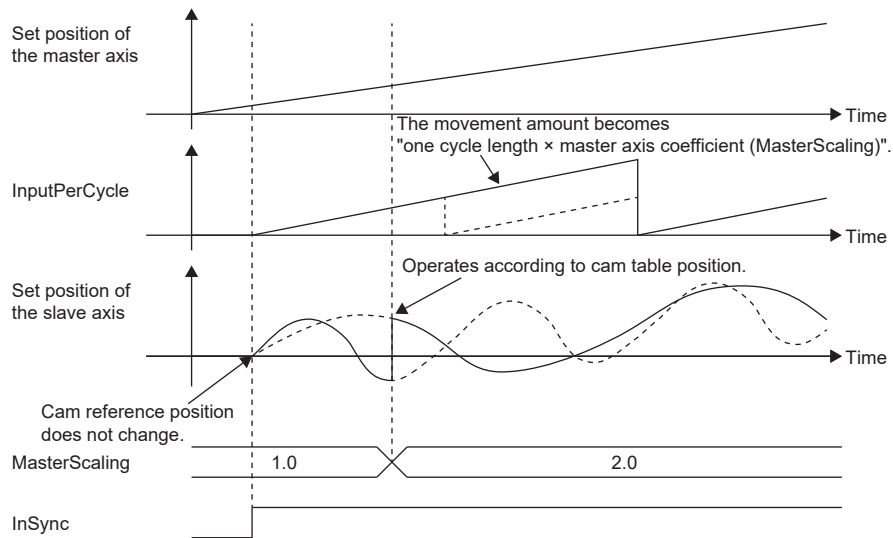
- When Start Mode (StartMode) is "0: Immediate (mclmmediate)"



### ■ Master axis scaling (MasterScaling)

Master axis scaling (MasterScaling) expands/reduces the cam table length per cycle.

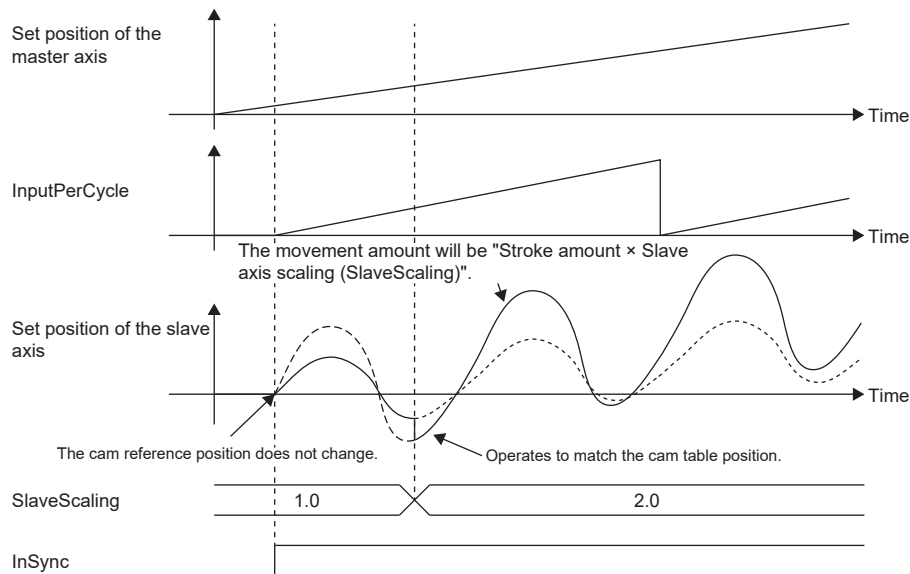
When changing during synchronization, a command equal to the movement amount is output to adjust the position of Slave axis (Slave) to the position of the cam table.



### ■ Slave axis scaling (SlaveScaling)

Slave axis scaling (SlaveScaling) expands/reduces the stroke amount of the cam table.

When changing during synchronization, a command equal to the movement amount is output to adjust the position of Slave axis (Slave) to the position of the cam table.



■Start mode (StartMode)

Sets the synchronization timing for cam operation and reflection timing for the cam control data.

For details on the synchronous timing for cam operation, refer to the following.

📖 Page 1799 Starting cam operation

If a value outside the range is set, Out of Start Mode Range (error code: 1AB5H) occurs.

After Cam Operation Start (MC\_CamIn) is executed, Controlling (Active) becomes TRUE if Current value per cycle (InputPerCycle) is synchronized, and In synchronization (InSync) becomes TRUE if Output value (OutputData) is synchronized.

For details on the application example for each setting value, refer to "Cam operation" in the following manual.

📖 User's manual for the controller used

The following shows the operation depending on the setting of Slave axis absolute coordinate (SlaveAbsolute).

| Setting value                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Immediate<br>(mclImmediate) | <div>The slave axis moves after Execution command (Execute) is started.</div> <div><div>■When slave axis absolute coordinate (SlaveAbsolute) is set to "FALSE: Relative coordinate"</div><div>Master axis current value</div><div>Master axis synchronization start position + master axis follow-up distance</div><div>Master axis synchronization start position</div><div>Current value per cycle</div><div>Slave axis current value</div><div>Execute</div><div>Busy</div><div>Active</div><div>InSync</div><div>EndOfProfile</div></div> <div><div>■When slave axis absolute coordinate (SlaveAbsolute) is set to "TRUE: Absolute coordinate"</div><div>Master axis current value</div><div>Master axis synchronization start position + master axis follow-up distance</div><div>Master axis synchronization start position</div><div>Current value per cycle</div><div>Slave axis current value</div><div>Execute</div><div>Busy</div><div>Active</div><div>InSync</div><div>EndOfProfile</div></div> |

| Setting value            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1: Absolute (mcAbsolute) | <p>The slave axis moves after Execution command (Execute) is started and the master axis cumulative current position passes Master axis synchronization start position (MasterSyncPosition).</p> <p>Checking of whether the Master axis cumulative current position has passed the Master axis synchronization start position (MasterSyncPosition) begins at the point when the Slave axis status becomes "7: During synchronous operation (SynchronizedMotion)".</p> <div style="display: flex; justify-content: space-around;"> <div style="width: 45%;"> <p>■ When slave axis absolute coordinate (SlaveAbsolute) is set to "FALSE: Relative coordinate"</p> </div> <div style="width: 45%;"> <p>■ When slave axis absolute coordinate (SlaveAbsolute) is set to "TRUE: Absolute coordinate"</p> </div> </div> |

### ■ Master axis data source selection (MasterValueSource)

Slave axis (Slave) sets the position type of Master axis (Master) that will execute single axis synchronous control.

The operation may differ depending on the execution order of the FBs or if the operation cycles of Master axis (Master) and Slave axis (Slave) are different.

Operates with the same value as the set value when specifying Actual value in Master axis data source selection (MasterValueSource) while an axis type other than real axis is set in Master axis (Master).

| Setting value                                  | Description                                                                     |
|------------------------------------------------|---------------------------------------------------------------------------------|
| 1: Set value (mcSetValue)                      | Uses the commanded position of the master axis in the previous operation cycle. |
| 2: Actual value (mcActualValue)                | Uses the actual position of the master axis in the previous operation cycle.    |
| 101: Latest set value (mcLatestSetValue)       | Uses the commanded position of the master axis in the current operation cycle.  |
| 102: Latest actual value (mcLatestActualValue) | Uses the actual position of the master axis in the current operation cycle.     |

### Point

When Master axis data source selection (MasterValueSource) is set to "1: Set value (mcSetValue)" or "101: Latest set value (mcLatestSetValue)" and the master axis becomes servo OFF by a servo alarm or forced stop, the amount of the value change may be too large. This can be prevented by setting Master axis data source selection (MasterValueSource) to "2: Actual value (mcActualValue)" or "102: Latest actual value (mcLatestActualValue)".

## ■ Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following buffer modes are settable in MC\_CamIn (Cam Operation Start).

The velocity for MC\_CamIn (Cam Operation Start) follows the synchronizing FB (the master axis) and this velocity changes immediately based on the master axis velocity and the set cam data when the FB is switched. The switching condition for each mode is shown below.

| Setting value            | Description                                                                                                                                                                                                                                       | Switching condition                              |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| 0: Aborting (mcAborting) | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                       | Always                                           |
| 1: Buffered (mcBuffered) | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB. | When Cam cycle completion (EndOfProfile) is TRUE |

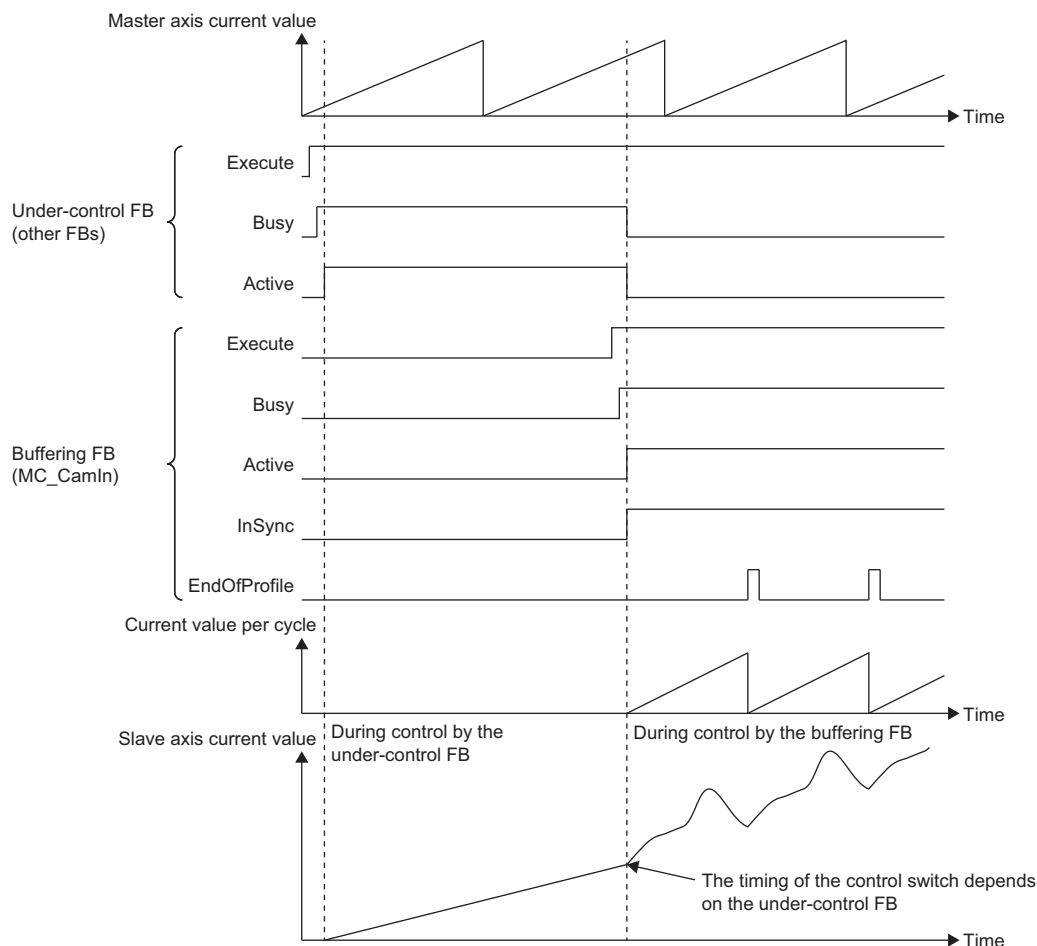


For details on multiple start (buffer mode), refer to the following.

User's manual for the controller used

### • Under-control FB and buffering FB (MC\_CamIn (Cam Operation Start))

If MC\_CamIn (Cam Operation Start) is activated while the under-control FB is controlling the slave axis specified for MC\_CamIn (Cam Operation Start), the control of the slave axis switches to MC\_CamIn (Cam Operation Start). The timing of switching control depends on the buffer mode (BufferMode) set for the FB being controlled and MC\_CamIn (Cam Operation Start).



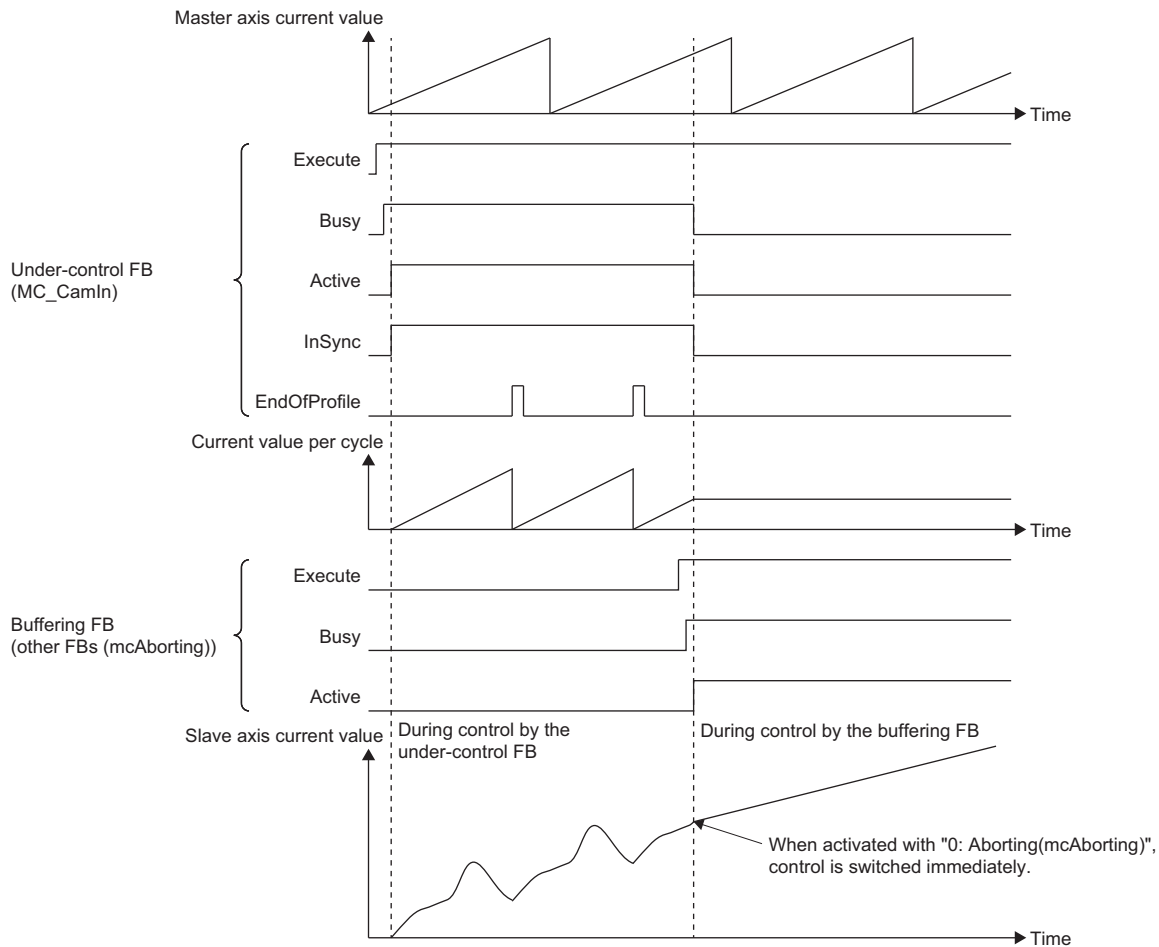


The speed in buffering FB (MC\_CamIn (Cam Operation Start) occurs when In synchronization (InSync) becomes TRUE.

When Start mode (StartMode) is set to a value other than "0: Immediate (mclImmediate)", In synchronization (InSync) does not become TRUE immediately after the FB starts so the velocity remains at 0 until Executing (Busy), Controlling (Active), and In synchronization (InSync) are all TRUE.

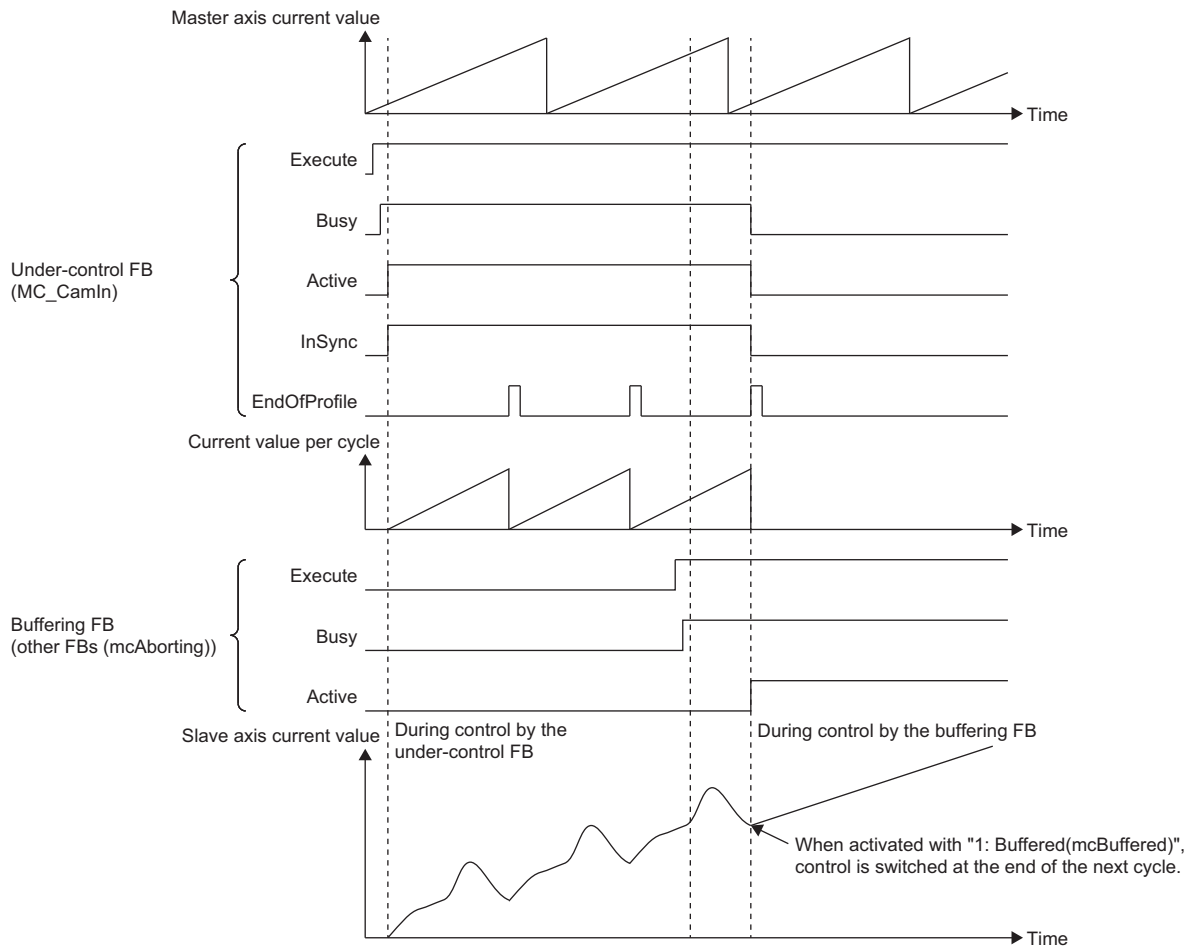
- Under-control FB (MC\_CamIn (Cam Operation Start)) and buffering FB (Buffer mode (BufferMode)) set to "0: Aborting (mcAborting)"

If another FB is activated for the slave axis specified for MC\_CamIn (Cam Operation Start) while MC\_CamIn (Cam Operation Start) is controlling the slave axis, control of the slave axis switches to the other FB. The timing of control switching depends on the buffer mode (BufferMode) of another FB. When "0: Aborting (mcAborting)" is specified, the control switches immediately.



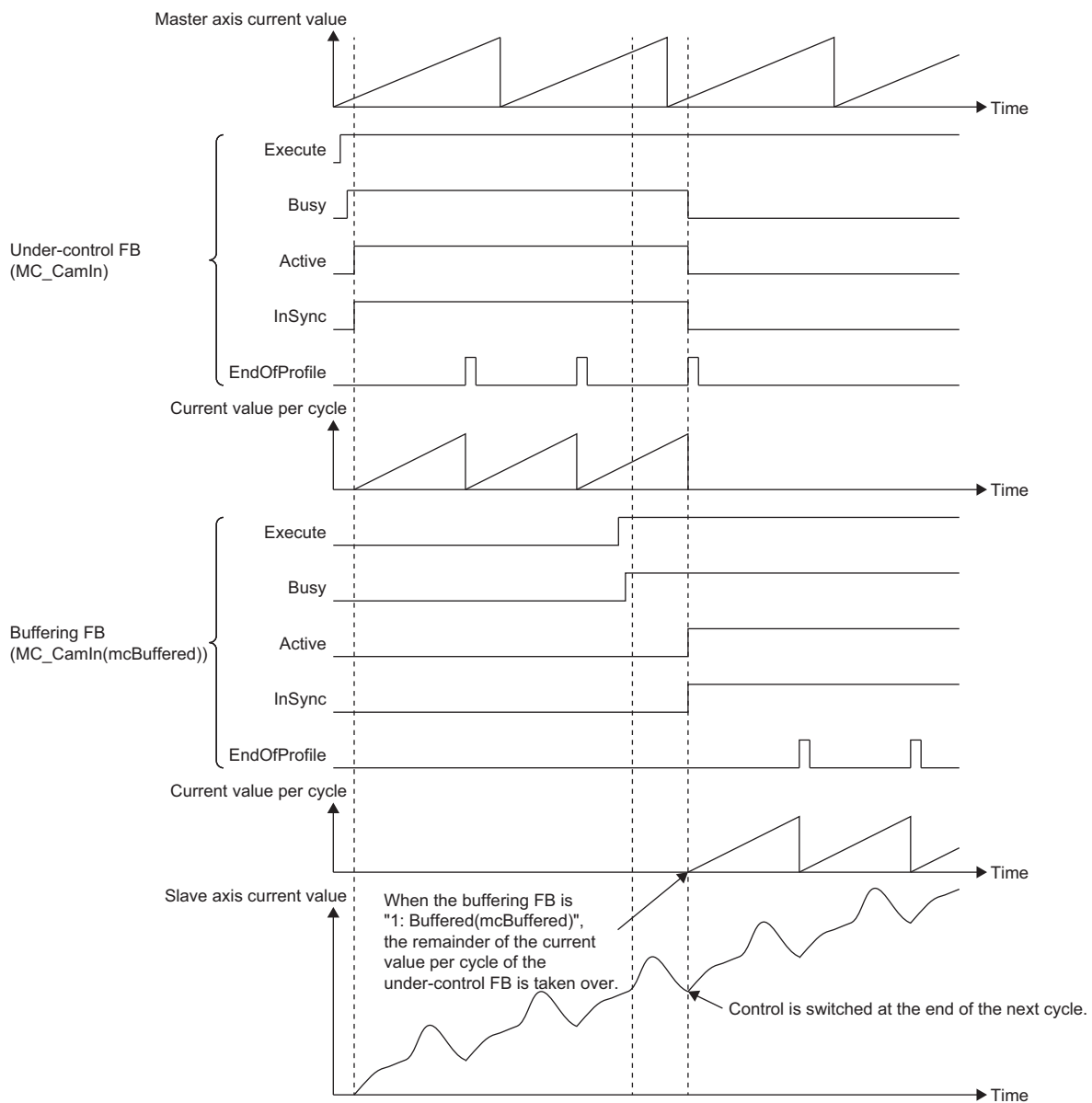
- Under-control FB (MC\_CamIn (Cam Operation Start)) and buffering FB (Buffer mode (BufferMode)) set to "1: Buffered (mcBuffered)"

If another FB is activated for the slave axis specified for MC\_CamIn (Cam Operation Start) while MC\_CamIn (Cam Operation Start) is controlling the slave axis, control of the slave axis switches to the other FB. The timing of control switching depends on the buffer mode (BufferMode) of another FB. When "1: Buffered (mcBuffered)" is specified, the control switches at the end of the next cycle.



- Under-control FB (MC\_CamIn (Cam Operation Start)) and buffering FB (MC\_CamIn (Cam Operation Start))

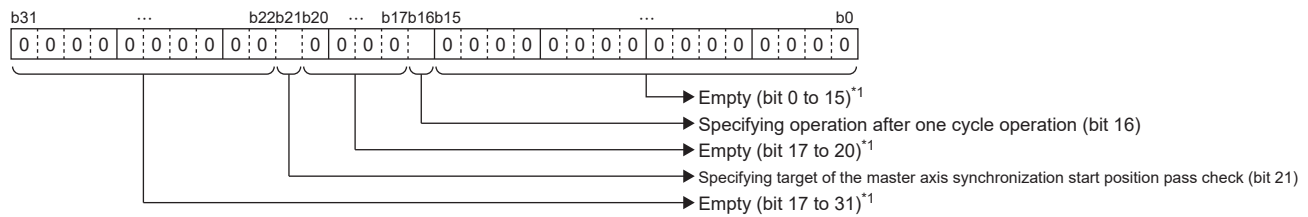
If another MC\_CamIn (Cam Operation Start) is activated while MC\_CamIn (Cam Operation Start) is controlling the slave axis, control of the slave axis switches. When buffer mode (BufferMode) in another MC\_CamIn (Cam Operation Start) is "1: Buffered (mcBuffered)", the position of the start point is adjusted so that the end point and start point of the cam data are the same.



## Options (Options)

The function options for MC\_CamIn (Cam Operation Start) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.

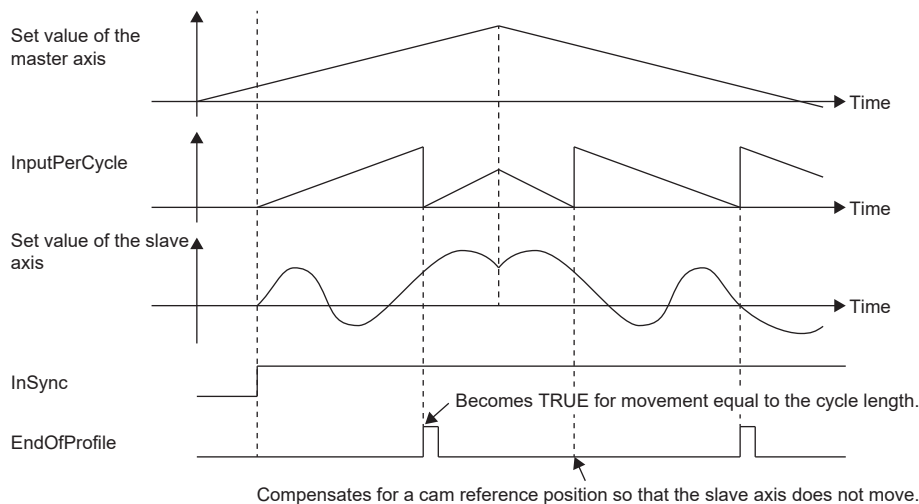


\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit | Name                                                                       | Description                                                                                                                                                                                                                                                                                                                                   |
|-----|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16  | Specifying operation after one cycle operation                             | Specifies the operation after one cycle operation when Periodic (Periodic) of MC_CamTableSelect (Cam Table Selection) is set to "FALSE: Periodic". <ul style="list-style-type: none"> <li>0: End</li> <li>1: Wait for restart</li> </ul>                                                                                                      |
| 21  | Specifying target of Master axis synchronization start position pass check | Sets the target of the Master axis synchronization start position (MasterSyncPosition) pass check. <ul style="list-style-type: none"> <li>0: Master axis cumulative current position, or where the feedback position has been converted to the cumulative position.</li> <li>1: Master axis set position, or the feedback position</li> </ul> |

## Cam cycle completion (EndOfProfile)

After Controlling (Active) becomes TRUE, this variable becomes TRUE only for one execution cycle of the POU (Program Organization Unit) that calls FB each time movement equal to the cycle length occurs.



## Current value per cycle (InputPerCycle)

"0.0" is used as the initial value.

After Controlling (Active) becomes TRUE, the movement amount of Master axis (Master) is reflected as shown below.

Current value per cycle = (Master axis cumulative movement amount - Master axis offset + Current value per cycle change value) MOD Current value per cycle

The monitor value range is the following cam length per cycle range set in the cam table.

$0 \leq \text{Current value per cycle (InputPerCycle) of MC\_CamIn (Cam Operation Start)} < (\text{Cam length per cycle} \times \text{Master axis scaling})$

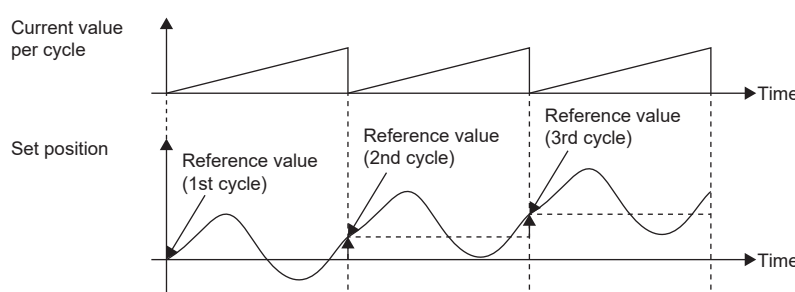
## ■Reference value (Reference)

When MC\_CamIn (Cam Operation Start) is executed, the reference value is calculated from the cam position start (cam current value per cycle) based on the set position where In synchronization (InSync) becomes TRUE.

- For subtracting the initial stroke amount in the cam table, the formula for initial values are shown below.

| Slave axis absolute coordinate (SlaveAbsolute)            | Formula                                                                                                                                                                                                                          |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FALSE (Relative coordinate)<br>TRUE (Absolute coordinate) | Reference value = Slave axis position when synchronization starts - (Stroke value based on cam position (current value per cycle) when In synchronization (InSync) changes to TRUE + Initial stroke amount) × Slave axis scaling |
|                                                           | Reference value = The cumulative current position corresponding to the set position being 0 when In synchronization (InSync) changes to TRUE.                                                                                    |

- The reference values used in two-way cam operation and feed cam operation are shown below.

| Operation                                                                                                           | Description                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| When Two-way cam operation, or Slave absolute coordinate (SlaveAbsolute) is "TRUE (Absolute Coordinate)"            | The reference value is not updated.                                                                                                                                                                                                                                                                                                 |
| When Feed cam operation as well as Slave axis absolute coordinate (SlaveAbsolute) are "FALSE (relative coordinate)" | <p>The reference value is calculated as shown below.</p> <ul style="list-style-type: none"> <li>Reference value = (Original reference value + (Stroke value at the last point - Stroke value at the 1st point) × Slave axis scaling)</li> </ul>  |

- The reference values are updated with the following timing.

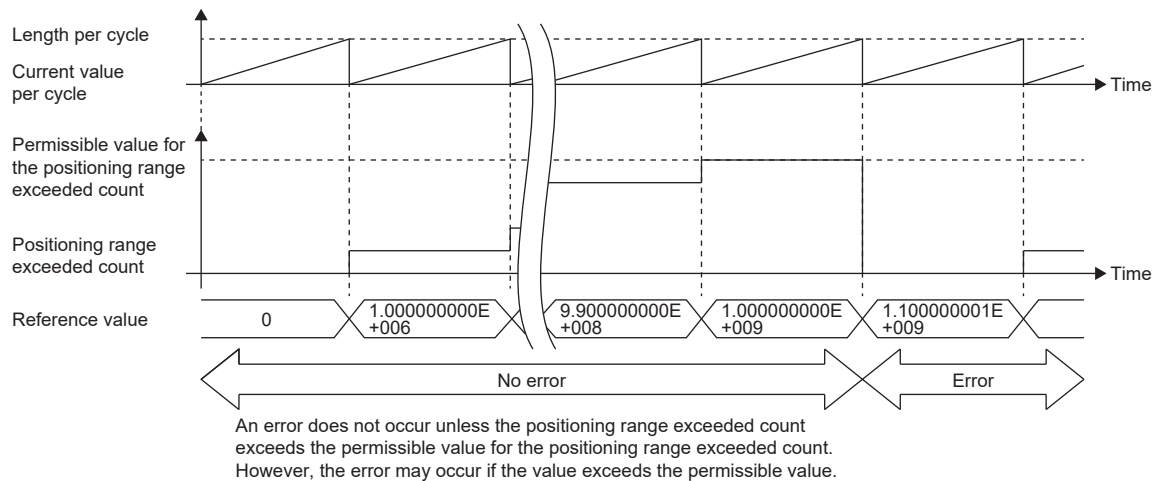
| Update timing                                                                                                                 | Reference value calculation formula                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| When Current value per cycle (InputPerCycle) going in the address increasing direction passes the last point of the cam table | Original reference value + ((Stroke value at the last point - Stroke value at the 1st point) × Slave axis scaling)   |
| When Current value per cycle (InputPerCycle) going in the address decreasing direction passes the 1st point of the cam table  | Original reference value - ((Stroke value at the last point - Stroke value at the 1st point) × Slave axis scaling)   |
| When the current value per cycle is changed (Completion (Done) is TRUE for MCv_ChangeCycle (Current Value Change per Cycle))  | Original reference value - (Stroke value corresponding to current value per cycle after change × Slave axis scaling) |

## &lt;Reference value errors&gt;

Performing any of the following operations may cause a reference value error to occur.

- If the number of TRUE outputs by Cam cycle completion (EndOfProfile) exceeds the permissible value after the FeedCam as well as In synchronization (InSync) become TRUE. \*1
- If the FeedCam as well as the setting for the following control parameters contains a decimal.
  - (Stroke value at the last point - Stroke value at the 1st point) · Slave axis scaling
- If current value per cycle change is repeated with relative selection.

\*1 While an error does not occur if the positioning range exceeded count is less than the permissible value for the positioning range exceeded count, an error may occur if the permissible value is exceeded. (Operation is continued regardless of whether or not a truncation error has occurred.)



If the reference value error becomes too large, clear the synchronization status or reset it by executing a current value change with absolute position specification.

The permissible value for the positioning range exceeded count is a variable value calculated with the following formula.

Permissible value for the positioning range exceeded count = Limit value for the positioning range exceeded count / ((Output value at the last point - Output value at the 1st point) / slave scaling)

\*: The limit value for the positioning range exceeded count is the upper limit value of the positioning range, "1000000000".

(Example)

When the output value at the 1st point is "0", the output value at the last point is "1000000", and the output coefficient is "10", the permissible value for the positioning range exceeded count becomes "100000".

The monitor value range is shown below.

- Ring counter lower limit value of the slave axis ≤ Reference value < Ring counter upper limit value of the slave axis

## ■Output value (OutputData)

The default value is the initial stroke amount in the cam table.

The update timing and calculation method of Output value (OutputData) are as follows.

| Update timing                                                               | Output value calculation method                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| While Controlling (Active) is TRUE and In synchronization (InSync) is FALSE | Reference value + ((Initial stroke amount in the cam table + Slave axis offset) × Slave axis scaling)<br>When Start mode (StartMode) is set to Ramp-in (mcRampIn), the output value is calculated toward the slave axis position at the start of synchronization from the above position.<br>For details, refer to the following.<br>☞ Page 1812 Start mode (StartMode)                                                           |
| While In synchronization (InSync) is TRUE                                   | <p>■When Interpolation method is set to Section interpolation or Spline interpolation</p> <p>Reference value + ((Stroke amount × Stroke ratio corresponding to current value per cycle) + Slave axis offset) × Slave axis scaling</p> <p>■When Cam data format is set to Linear interpolation</p> <p>Reference value + ((Output value corresponding to cam current value per cycle) + Slave axis offset) × Slave axis scaling</p> |

## Precautions

- When Master axis offset (MasterOffset), Slave axis offset (SlaveOffset), Master axis scaling (MasterScaling), Slave axis scaling (SlaveScaling), or Cam table ID (CamTableID) are changed, the slave axis may move suddenly at the start of control or a control change. This sudden movement may cause a shock to the equipment, so it is important to carefully check the setting values and the change timing.
- When monitoring the axis being cam controlled with the engineering tool, the position, velocity, etc. is based on the unit setting of the axis. Units for the cycle length, stroke amount, etc. set in the operation profile data are not used.

## Program example

The following is a program example. The cam operation start command (bCamInStart) is set to TRUE, Axis 2 (Axis0002) is set as the master axis to be started in JOG operation, and cam operation of the slave axis (Axis0001) is performed according to the operation profile data (cam data 1).

- Setting

| Item                           |              | Setting value |
|--------------------------------|--------------|---------------|
| Data setting for JOG operation | Velocity     | 1000.0        |
|                                | Acceleration | 5000.0        |
|                                | Deceleration | 5000.0        |
|                                | Jerk         | 0.0           |

## ■Axes

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |
| 2        | Axis0002   | AXIS_REF  | Axis 2  |

## ■Operation profile data

| Profile ID | Label name      | Data type  | Comment    |
|------------|-----------------|------------|------------|
| 1          | ProfileData0001 | MC_CAM_REF | Cam data 1 |

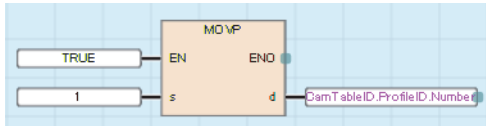
## ■Labels used

| Label name         | Data type                           | Comment                     |
|--------------------|-------------------------------------|-----------------------------|
| MC_CamIn_1         | MC_CamIn                            | Cam Operation Start FB      |
| bCamInStart        | Bit                                 | Cam operation start command |
| CamTableID         | MC_CAM_ID                           | Cam table ID                |
| bInSync            | Bit                                 | In synchronization          |
| bCamBusy           | Bit                                 | Executing                   |
| bCamActive         | Bit                                 | Controlling                 |
| bCamCommandAborted | Bit                                 | Abortion of execution       |
| bCamError          | Bit                                 | Error                       |
| uwCamErrorID       | Word [unsigned]/bit string [16-bit] | Error code                  |
| bEndOfProfile      | Bit                                 | Cam cycle completion        |
| MCv_Jog_1          | MCv_Jog                             | JOG FB                      |
| leJogVelocity      | Double-precision real number        | JOG velocity                |
| leJogAcceleration  | Double-precision real number        | JOG acceleration            |
| leJogDeceleration  | Double-precision real number        | JOG deceleration            |
| leJogJerk          | Double-precision real number        | JOG jerk                    |
| bJogDone           | Bit                                 | Execution completion        |
| bJogBusy           | Bit                                 | Executing                   |
| bJogActive         | Bit                                 | Controlling                 |
| bJogCommandAborted | Bit                                 | Abortion of execution       |
| bJogError          | Bit                                 | Error                       |
| uwJogErrorID       | Word [unsigned]/bit string [16-bit] | Error code                  |

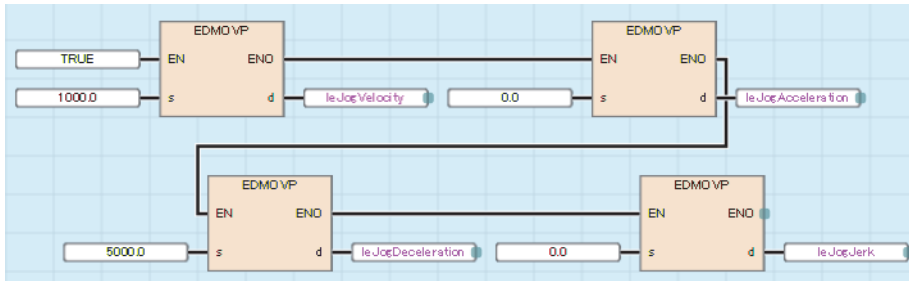


## ■FBD/LD program

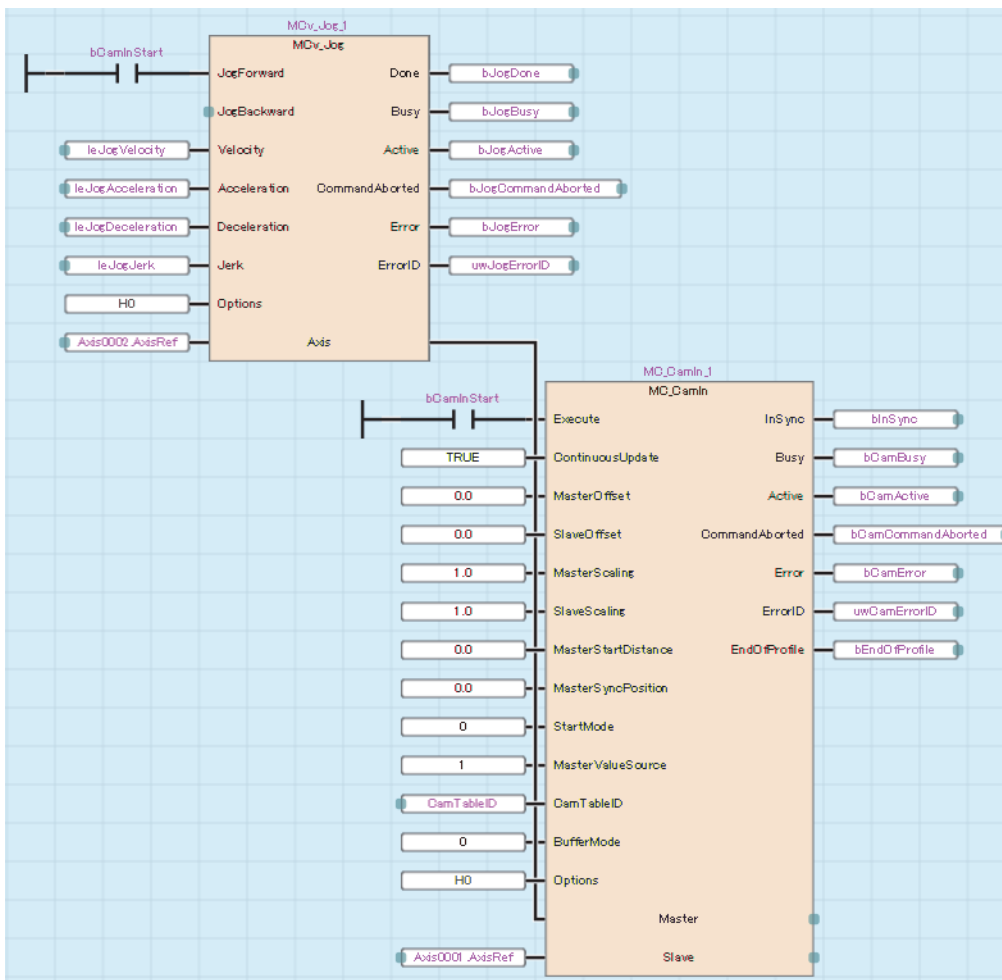
- Operation profile data (cam data) settings



- Data settings for JOG operation



- JOG operation/Cam operation start



## ■ST program

//-----Operation profile data (cam data) settings-----

CamTableID.ProfileID.Number:= 1;

//-----Data settings for JOG operation-----

leJogVelocity:= 1000.0;

leJogAcceleration:= 5000.0;

leJogDeceleration:= 5000.0;

leJogJerk:= 0.0;

//-----JOG-----

MCv\_Jog\_1(

Axis:= Axis0002.AxisRef ,

JogForward:= bCamInStart ,

Velocity:= leJogVelocity ,

Acceleration:= leJogAcceleration ,

Deceleration:= leJogDeceleration ,

Jerk:= leJogJerk ,

Options:= H00000000 ,

Done=> bJogDone ,

Busy=> bJogBusy ,

Active=> BJogActive ,

CommandAborted=> bJogCommandAborted ,

Error=> bJogError ,

ErrorID=> uwJogErrorID

);

//-----Cam Operation Start-----

MC\_CamIn\_1(

Master:= Axis0002.AxisRef ,

Slave:= Axis0001.AxisRef ,

Execute:= bCamInStart ,

ContinuousUpdate:= TRUE ,

MasterOffset:= 0.0 ,

SlaveOffset:= 0.0 ,

MasterScaling:= 1.0 ,

SlaveScaling:= 1.0 ,

MasterStartDistance:= 0.0 ,

MasterSyncPosition:= 0.0 ,

StartMode:= MC\_START\_MODE\_\_mcImmediate ,

MasterValueSource:= MC\_SOURCE\_\_mcSetValue ,

CamTableID:= CamTableID ,

BufferMode:= MC\_BUFFER\_MODE\_\_mcAborting ,

Options:= H00000000 ,

InSync=> bInSync ,

Busy=> bCamBusy ,

Active=> bCamActive ,

CommandAborted=> bCamCommandAborted ,

Error=> bCamError ,

ErrorID=> uwCamErrorID ,

EndOfProfile=> bEndOfProfile

);

# 46.15 Gear Operation Start

46

## MC\_GearIn

This FB starts gear operation according to the specified gear ratio.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MC_GearIn(   Master:= ?AXIS_REF? ,   Slave:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   RatioNumerator:= ?DINT? ,   RatioDenominator:= ?DWORD? ,   MasterValueSource:= ?INT? ,   Acceleration:= ?LREAL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   InGear=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

## Setting data

### I/O variables

| I/O variable | Name        | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                      |
|--------------|-------------|-----------|----------|-------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Master       | Master axis | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>☞ Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |
| Slave        | Slave axis  | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>☞ Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

### Input variable

| Input variable   | Name                 | Data type | Input                                                          | Valid range               | Default value | Description                                                                                                                                                                                                                                      |
|------------------|----------------------|-----------|----------------------------------------------------------------|---------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute          | Execution command    | BOOL      | At start                                                       | TRUE, FALSE               | FALSE         | When this variable is set to TRUE, MC_GearIn (Gear Operation Start) is executed.                                                                                                                                                                 |
| ContinuousUpdate | Continuous update    | BOOL      | At start                                                       | TRUE, FALSE               | FALSE         | Whether to enable or disable continuous change of Gear ratio numerator (RatioNumerator), Gear ratio denominator (RatioDenominator), Acceleration (Acceleration), and Deceleration (Deceleration) is set.<br>• FALSE: Disabled<br>• TRUE: Enabled |
| RatioNumerator   | Gear ratio numerator | DINT      | At start/<br>Retrigger possible/<br>Continuous update possible | -2147483648 to 2147483647 | 1             | The numerator value of Master axis (Master) is set.<br>For details, refer to the following.<br>☞ Page 1830 Gear ratio numerator (RatioNumerator)/Gear ratio denominator (RatioDenominator)                                                       |

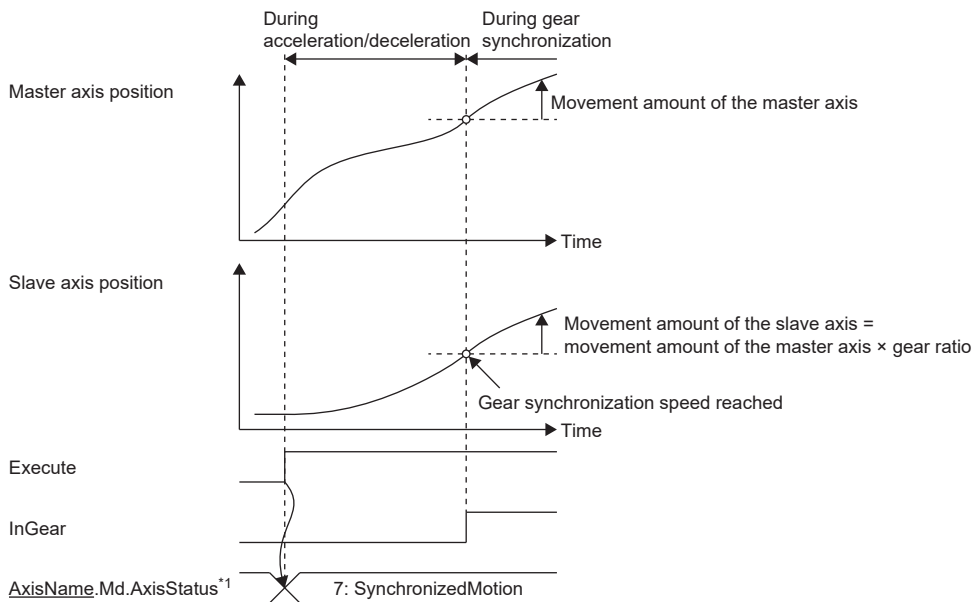
| Input variable    | Name                              | Data type            | Input                                                          | Valid range                    | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------|-----------------------------------|----------------------|----------------------------------------------------------------|--------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RatioDenominator  | Gear ratio denominator            | DWORD(UDINT)         | At start/<br>Retrigger possible/<br>Continuous update possible | 1 to 2147483647                | 1             | The denominator value of Master axis (Master) is set.<br>For details, refer to the following.<br> Page 1830 Gear ratio numerator (RatioNumerator)/Gear ratio denominator (RatioDenominator)                                                                                                                                                                                                        |
| MasterValueSource | Master axis data source selection | INT (MC_SOURCE)      | At start                                                       | 1, 2, 101, 102                 | 1             | The data source of Master axis (Master) is set.<br><ul style="list-style-type: none"> <li>• 1: Set value (mcSetValue)</li> <li>• 2: Actual value (mcActualValue)</li> <li>• 101: Latest set value (mcLatestSetValue)</li> <li>• 102: Latest actual value (mcLatestActualValue)</li> </ul> For details, refer to the following.<br> Page 1831 Master axis data source selection (MasterValueSource) |
| Acceleration      | Acceleration                      | LREAL                | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The acceleration used for accelerating is set.<br>When the target velocity is reached, Gear ratio reached (InGear) becomes TRUE and Slave axis (Slave) is controlled using a velocity equal to the velocity of Master axis (Master) converted by the gear ratio.                                                                                                                                                                                                                      |
| Deceleration      | Deceleration                      | LREAL                | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The deceleration used for decelerating is set.<br>When the target velocity is reached, Gear ratio reached (InGear) becomes TRUE and Slave axis (Slave) is controlled using a velocity equal to the velocity of Master axis (Master) converted by the gear ratio.                                                                                                                                                                                                                      |
| Jerk              | Jerk                              | LREAL                | At start                                                       | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The jerk at acceleration/deceleration start is set.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| BufferMode        | Buffer mode                       | INT (MC_BUFFER_MODE) | At start                                                       | 0, 1                           | 0             | The buffer mode is set.<br><ul style="list-style-type: none"> <li>• 0: Aborting (mcAborting)</li> <li>• 1: Buffered (mcBuffered)</li> </ul> For details, refer to the following.<br> Page 1831 Buffer mode (BufferMode)                                                                                                                                                                          |
| Options           | Options                           | DWORD(HEX)           | At start                                                       | 00000000H                      | 00000000H     | Set "00000000H".<br>* If a value other than "00000000H" is set, Out of Options Range (error code: 1ABBH) occurs.                                                                                                                                                                                                                                                                                                                                                                      |

## ■ Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                     |
|-----------------|-----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InGear          | Gear ratio reached    | BOOL       | FALSE         | This variable becomes TRUE when the gear synchronization speed is reached.                                                                                                                                                                      |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MC_GearIn (Gear Operation Start) is executed.                                                                                                                                                                   |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE when Slave axis (Slave) is being controlled.                                                                                                                                                                         |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_GearIn (Gear Operation Start) is aborted.<br>The variable becomes FALSE when Execution command (Execute) becomes FALSE.                                                                         |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |

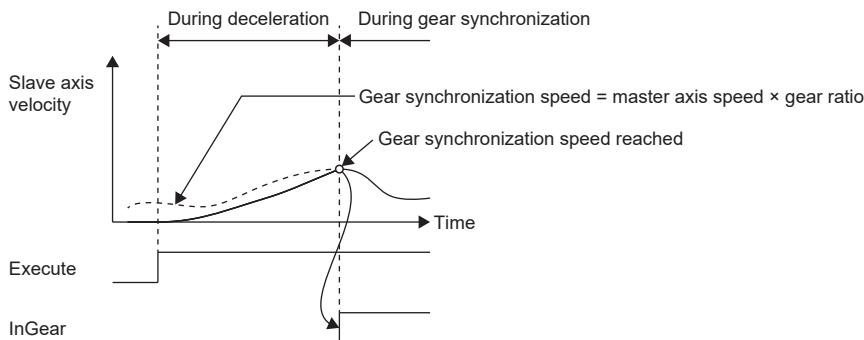
## Processing details

- This FB sets Gear ratio numerator (RatioNumerator), Gear ratio denominator (RatioDenominator), Master axis data source selection (MasterValueSource), Acceleration (Acceleration), Deceleration (Deceleration), Jerk (Jerk), and Buffer mode (BufferMode), and starts the gear operation.
- To stop the operation, perform MC\_Stop (Forced Stop).
- After executing this FB, Slave axis (Slave) performs acceleration/deceleration until reaching the target velocity, the value of which is the velocity of Master axis (Master) converted by the gear ratio. After reaching the target velocity, Gear ratio reached (InGear) becomes TRUE, and Slave axis (Slave) is controlled using a velocity equal to the velocity of Master axis (Master) converted by the gear ratio.



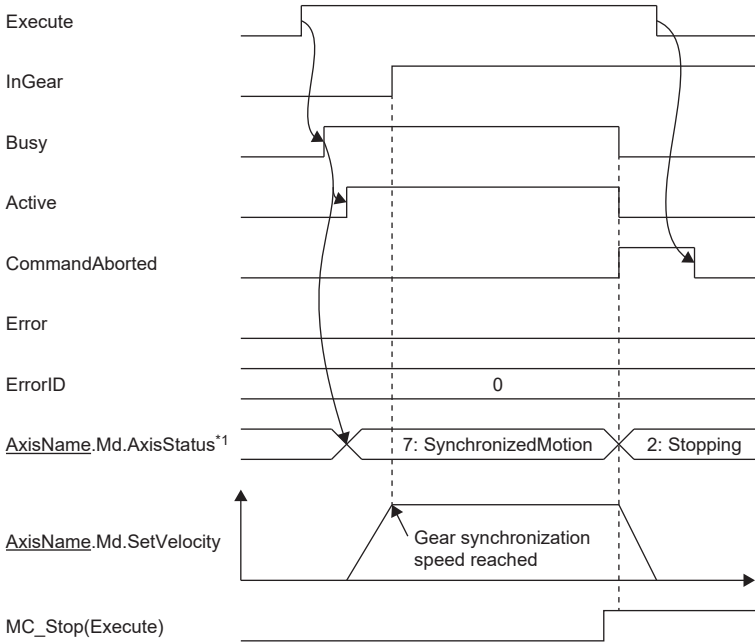
\*1 Axis status of Slave axis (Slave)

- When the velocity of Master axis (Master) is changed during acceleration/deceleration, the gear synchronization speed is also updated.



■Timing chart

- When the processing is completed successfully



\*1 Axis status of Slave axis (Slave)

- When the processing is completed with an error

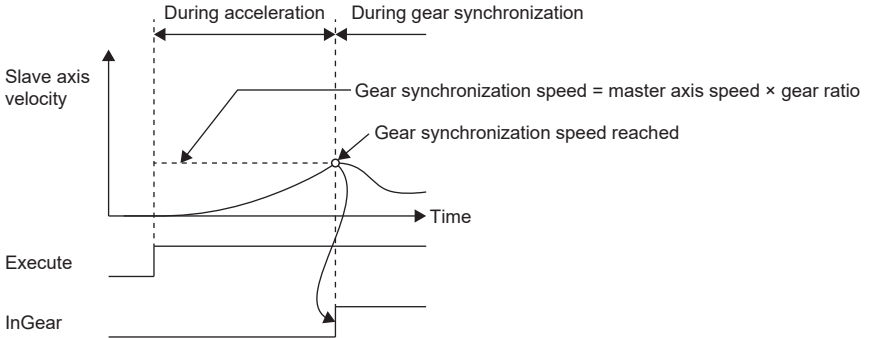
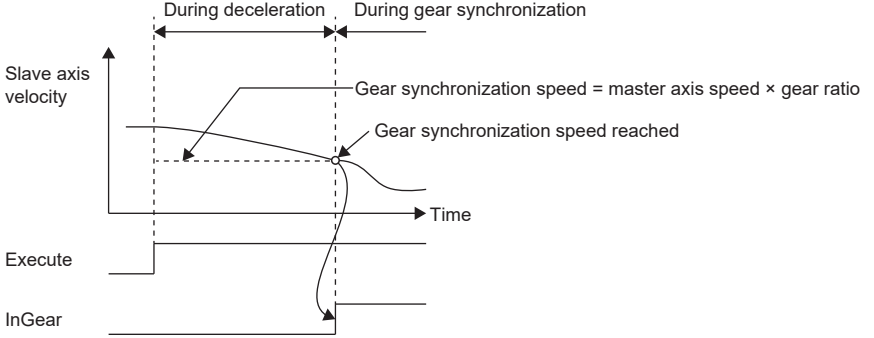
For the timing chart, refer to the following.

📖 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

■Acceleration/deceleration until reaching the gear synchronization speed

- The acceleration/deceleration method for MC\_GearIn (Gear Operation Start) is the acceleration/deceleration specification method.
- Depending on the velocity and target velocity of the slave axis (Slave) at operation start, one of the following 4 types of acceleration/deceleration is performed. The type of acceleration/deceleration will not change even if the target velocity is updated during the acceleration/deceleration.

| Slave axis (Slave) velocity and target velocity                                                                                                | Acceleration/deceleration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Slave axis (Slave) velocity < 0 < Gear synchronization speed<br>Alternatively,<br>Slave axis (Slave) velocity > 0 > Gear synchronization speed | <p>Deceleration is performed to velocity 0, then acceleration is performed from velocity 0 to the gear synchronization speed.</p> <p>The graph shows Slave axis speed on the y-axis and Time on the x-axis. The speed starts at a negative value, decelerates to 0, and then accelerates to a positive value labeled 'Gear synchronization speed'. The 'Gear synchronization speed' is defined as Master axis speed × Gear ratio. The graph is divided into three phases: 'Deceleration operation', 'Acceleration operation', and 'During gear synchronization'. The 'Execute' signal starts high, drops to low during the 'Deceleration operation' phase, and returns to high at the end. The 'InGear' signal starts high, drops to low during the 'Deceleration operation' phase, and returns to high at the end.</p> |

| Slave axis (Slave) velocity and target velocity                                            | Acceleration/deceleration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Slave axis (Slave) velocity (Absolute value) < Gear synchronization speed (Absolute value) | <p>Acceleration is performed until reaching the gear synchronization speed.</p>  <p>The graph illustrates the acceleration phase where the slave axis velocity is below the gear synchronization speed. The y-axis represents 'Slave axis velocity' and the x-axis represents 'Time'. A horizontal dashed line indicates the 'Gear synchronization speed = master axis speed × gear ratio'. The slave axis velocity curve starts at a lower value and accelerates until it reaches this synchronization speed. The 'Execute' signal is a step function that starts at the beginning of the acceleration phase. The 'InGear' signal becomes TRUE when the slave axis velocity reaches the gear synchronization speed. The graph is divided into 'During acceleration' and 'During gear synchronization' phases.</p>   |
| Slave axis (Slave) velocity (Absolute value) > Gear synchronization speed (Absolute value) | <p>Acceleration is performed until reaching the gear synchronization speed.</p>  <p>The graph illustrates the deceleration phase where the slave axis velocity is above the gear synchronization speed. The y-axis represents 'Slave axis velocity' and the x-axis represents 'Time'. A horizontal dashed line indicates the 'Gear synchronization speed = master axis speed × gear ratio'. The slave axis velocity curve starts at a higher value and decelerates until it reaches this synchronization speed. The 'Execute' signal is a step function that starts at the beginning of the deceleration phase. The 'InGear' signal becomes TRUE when the slave axis velocity reaches the gear synchronization speed. The graph is divided into 'During deceleration' and 'During gear synchronization' phases.</p> |
| Slave axis (Slave) velocity = Gear synchronization speed                                   | <p>Acceleration/deceleration is not performed.<br/>After operation is started, Gear ratio reached (InGear) becomes TRUE immediately and Slave axis (Slave) is controlled using a velocity equal to the velocity of Master axis (Master) converted by the gear ratio.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## ■ Gear ratio numerator (RatioNumerator)/Gear ratio denominator (RatioDenominator)

Gear ratio numerator (RatioNumerator) and Gear ratio denominator (RatioDenominator) are set together.

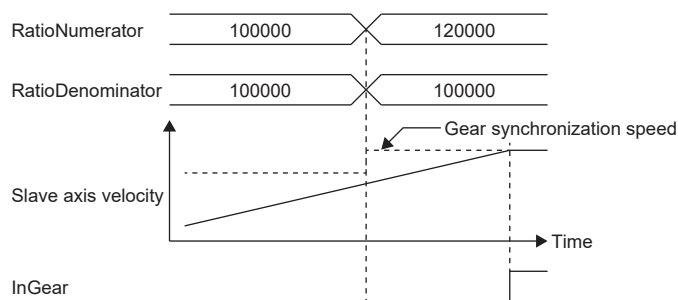
Gear ratio numerator (RatioNumerator) sets the numerator value for converting and transmitting the velocity of Master axis (Master).

Gear ratio denominator (RatioDenominator) sets the denominator value for converting and composing the movement amount of Master axis (Master).

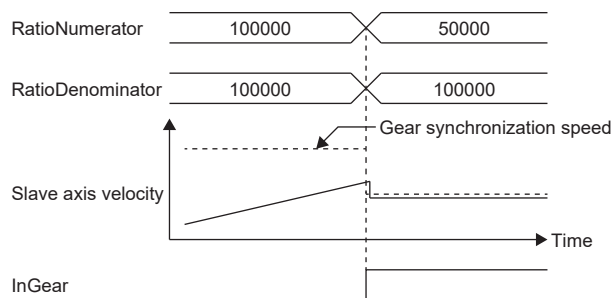
The velocity is converted as shown below.

$$\text{Master axis (Master) velocity after conversion} = \text{master axis (Master) velocity before conversion} \times \frac{\text{Gear ratio numerator (RatioNumerator)}}{\text{Gear ratio denominator (RatioDenominator)}}$$

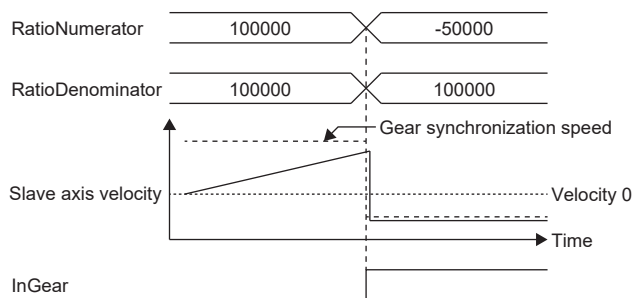
- Set a positive value in Gear ratio denominator (RatioDenominator).
- The velocity direction can be reversed and transmitted by setting a negative value in Ratio numerator (RatioNumerator).  
The gear synchronization speed is changed if the gear ratio is changed during acceleration/deceleration. Therefore, the velocity of Slave axis (Slave) is changed directly and the gear operation may start because of the change of the gear synchronization speed.
- The velocity of Master axis (Master) after conversion can be set to "0" by setting the value of Gear ratio numerator (RatioNumerator) to "0".
- The target velocity is changed if the gear ratio is changed during acceleration/deceleration. Therefore, changing the target velocity may directly change the velocity of Slave axis (Slave) and start the gear operation.
  - Changing the gear ratio during acceleration/deceleration
    - Gear ratio increase (set to a value higher than the velocity of Slave axis (Slave))



- Gear ratio decrease (set to a value higher than the velocity of Slave axis (Slave))

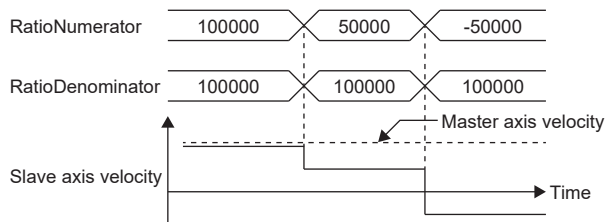


- Gear ratio direction reverse (set the gear synchronization speed to a value lower than "0")





- When the gear ratio is changed during gear synchronization, the velocity of Slave axis (Slave) is changed directly.
  - Gear ratio change during gear synchronization



### Master axis data source selection (MasterValueSource)

Slave axis (Slave) sets the position type of Master axis (Master) that will execute single axis synchronous control.

The operation may differ depending on the execution order of the FBs or if the operation cycles of Master axis (Master) and Slave axis (Slave) are different.

Operates with the same value as the set value when specifying Actual value in Master axis data source selection (MasterValueSource) while an axis type other than real axis is set in Master axis (Master).

| Setting value                                  | Description                                                                     |
|------------------------------------------------|---------------------------------------------------------------------------------|
| 1: Set value (mcSetValue)                      | Uses the commanded position of the master axis in the previous operation cycle. |
| 2: Actual value (mcActualValue)                | Uses the actual position of the master axis in the previous operation cycle.    |
| 101: Latest set value (mcLatestSetValue)       | Uses the commanded position of the master axis in the current operation cycle.  |
| 102: Latest actual value (mcLatestActualValue) | Uses the actual position of the master axis in the current operation cycle.     |

#### Point

When Master axis data source selection (MasterValueSource) is set to "1: Set value (mcSetValue)" or "101: Latest set value (mcLatestSetValue)" and the master axis becomes servo OFF by a servo alarm or forced stop, the amount of the value change may be too large. This can be prevented by setting Master axis data source selection (MasterValueSource) to "2: Actual value (mcActualValue)" or "102: Latest actual value (mcLatestActualValue)".

### Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following buffer modes are settable in MC\_GearIn (Gear Operation Start).

| Setting value            | Description                                                                                                                                                                                                                                       |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting) | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                       |
| 1: Buffered (mcBuffered) | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB. |

#### Point

For details on multiple start (buffer mode), refer to the following.

User's manual for the controller used

### Precautions

- When the gear ratio is changed, the velocity of the slave axis is changed directly. To smooth the speed change, use the buffer mode together with MCv\_SmoothingFilter (Smoothing Filter).
- When the velocity of Master axis (Master) after conversion is over the acceleration/deceleration time upper limit value during acceleration/deceleration operation, Acceleration Time Limit Over Warning (event code: 00D04H) or Deceleration Time Limit Over Warning (event code: 00D05H) will occur, the acceleration/deceleration operation is stopped, and the operation is restarted and continued at the velocity in the warning detection. If the warnings shown above occur, adjust the velocity of Master axis (Master) after conversion, Acceleration (Acceleration), and Deceleration (Deceleration) so that the setting for each does not exceed the acceleration/deceleration upper limit value.

## Program example

The following is a program example. The gear operation start command (bGearInStart) is set to TRUE, Axis 1 (Axis0001) is set as the master axis to be started in JOG operation, and gear operation of the slave axis (Axis0002) is performed according to the specified gear ratio.

- Setting

| Item                             |              | Setting value |
|----------------------------------|--------------|---------------|
| Data settings for gear operation | Acceleration | 5000.0        |
|                                  | Deceleration | 5000.0        |
|                                  | Jerk         | 0.0           |
| Data settings for JOG operation  | Velocity     | 1000.0        |
|                                  | Acceleration | 5000.0        |
|                                  | Deceleration | 5000.0        |
|                                  | Jerk         | 0.0           |

## ■Axes

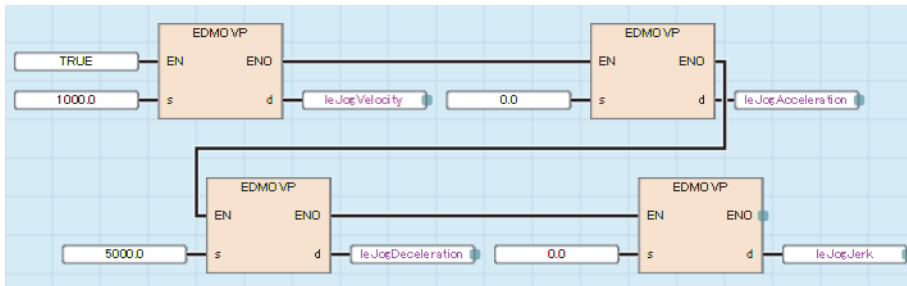
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |
| 2        | Axis0002   | AXIS_REF  | Axis 2  |

## ■Labels used

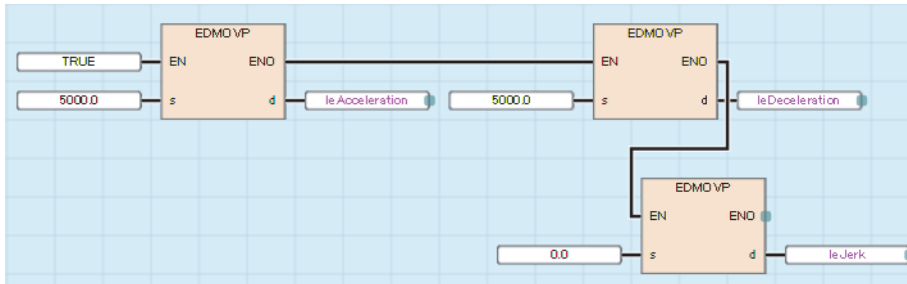
| Label name          | Data type                           | Comment                      |
|---------------------|-------------------------------------|------------------------------|
| MC_GearIn_1         | MC_GearIn                           | Gear Operation Start FB      |
| bGearInStart        | Bit                                 | Gear operation start command |
| leAcceleration      | Double-precision real number        | Acceleration                 |
| leDeceleration      | Double-precision real number        | Deceleration                 |
| leJerk              | Double-precision real number        | Jerk                         |
| bInGear             | Bit                                 | In synchronization           |
| bGearBusy           | Bit                                 | Executing                    |
| bGearActive         | Bit                                 | Controlling                  |
| bGearCommandAborted | Bit                                 | Abortion of execution        |
| bGearError          | Bit                                 | Error                        |
| uwGearErrorID       | Word [unsigned]/bit string [16-bit] | Error code                   |
| MCv_Jog_1           | MCv_Jog                             | JOG FB                       |
| leJogVelocity       | Double-precision real number        | JOG velocity                 |
| leJogAcceleration   | Double-precision real number        | JOG acceleration             |
| leJogDeceleration   | Double-precision real number        | JOG deceleration             |
| leJogJerk           | Double-precision real number        | JOG jerk                     |
| bJogDone            | Bit                                 | Execution completion         |
| bJogActive          | Bit                                 | Controlling                  |
| bJogCommandAborted  | Bit                                 | Abortion of execution        |
| bJogError           | Bit                                 | Error                        |
| uwJogErrorID        | Word [unsigned]/bit string [16-bit] | Error code                   |

## ■ FBD/LD program

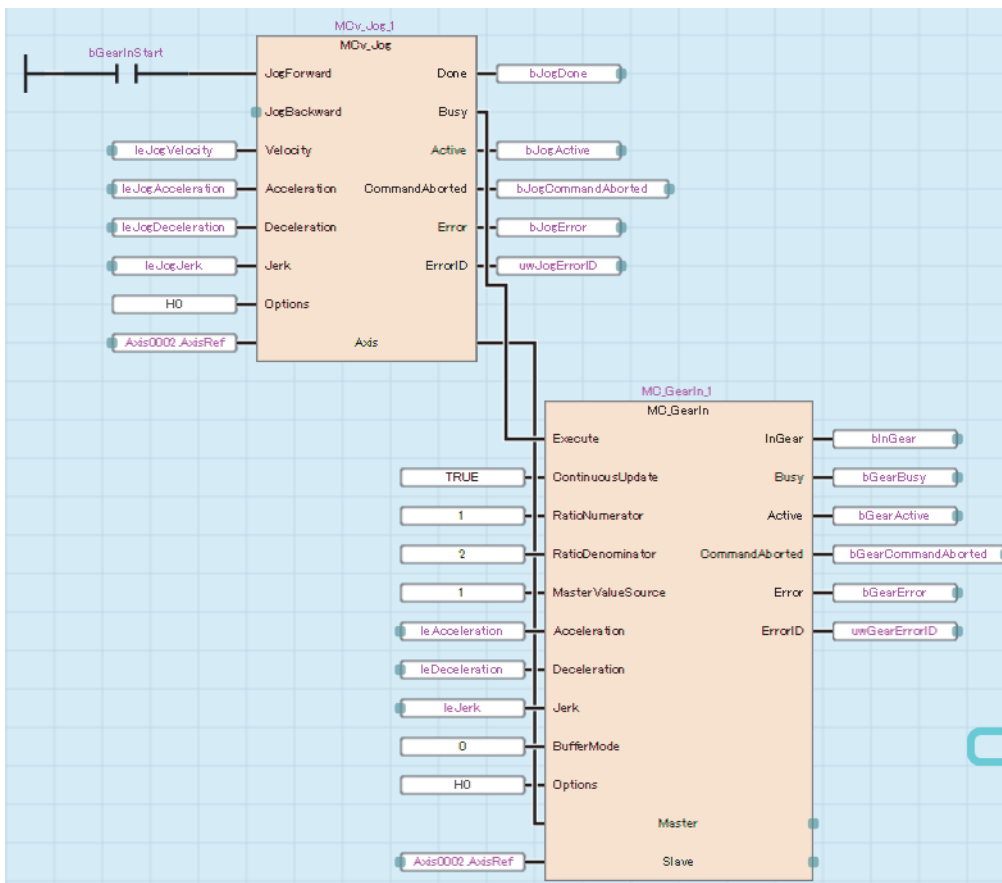
- Data settings for JOG operation



- Data settings for gear operation



- JOG/Gear Operation Start



## ■ST program

//-----Data settings for JOG operation-----

```
leJogVelocity:= 1000.0;
leJogAcceleration:= 5000.0;
leJogDeceleration:= 5000.0;
leJogJerk:= 0.0;
```

//-----Data settings for gear operation-----

```
leAcceleration:= 5000.0;
leDeceleration:= 5000.0;
leJerk:= 0.0;
```

//-----JOG-----

```
MCv_Jog_1(
  Axis:= Axis0001.AxisRef ,
  JogForward:= bGearInStart ,
  Velocity:= leJogVelocity ,
  Acceleration:= leJogAcceleration ,
  Deceleration:= leJogDeceleration ,
  Jerk:= leJogJerk ,
  Options:= H00000000 ,
  Done=> bJogDone ,
  Busy=> bJogBusy ,
  Active=> BJogActive ,
  CommandAborted=> bJogCommandAborted ,
  Error=> bJogError ,
  ErrorID=> uwJogErrorID
);
```

//-----Gear Operation Start-----

```
MC_GearIn_1(
  Master:= Axis0001.AxisRef ,
  Slave:= Axis0002.AxisRef ,
  Execute:= bJogBusy ,
  ContinuousUpdate:= TRUE ,
  RatioNumerator:= 1 ,
  RatioDenominator:= 2 ,
  MasterValueSource:= MC_SOURCE__mcSetValue ,
  Acceleration:= leAcceleration ,
  Deceleration:= leDeceleration ,
  Jerk:= leJerk ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= H00000000 ,
  InGear=> bInGear ,
  Busy=> bGearBusy ,
  Active=> bGearActive ,
  CommandAborted=> bGearCommandAborted ,
  Error=> bGearError ,
  ErrorID=> uwGearErrorID
);
```

# 46.16 Addition/Subtraction Positioning

46

## MC\_CombineAxes

This FB adds or subtracts the movement amounts of the two specified master axes and performs positioning using said value as the commanded position.

| Ladder                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | FBD/LD                                                                                                                                                                                                                                                                                                                                                                                        | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>MC_CombineAxes</div> <div> DUT: Master1 ————— Master1 :DUT<br/> DUT: Master2 ————— Master2 :DUT<br/> DUT: Slave ————— Slave :DUT<br/> B: Execute ————— InSync :B<br/> B: ContinuousUpdate ————— Busy :B<br/> ENUM: CombineMode ————— Active :B<br/> D: GearRatioNumeratorM1 CommandAborted :B<br/> UD: GearRatioDenominatorM1 Error :B<br/> D: GearRatioNumeratorM2 ErrorID :UW<br/> UD: GearRatioDenominatorM2<br/> ENUM: MasterValueSourceM1<br/> ENUM: MasterValueSourceM2<br/> ENUM: BufferMode<br/> UD: Options </div> | <div>MC_CombineAxes</div> <div> Execute ————— InSync<br/> ContinuousUpdate ————— Busy<br/> CombineMode ————— Active<br/> GearRatioNumeratorM1 CommandAborted<br/> GearRatioDenominatorM1 Error<br/> GearRatioNumeratorM2 ErrorID<br/> GearRatioDenominatorM2<br/> MasterValueSourceM1<br/> MasterValueSourceM2<br/> BufferMode<br/> Options<br/> <br/> Master1<br/> Master2<br/> Slave </div> | <pre> MC_CombineAxes(   Master1:= ?AXIS_REF? ,   Master2:= ?AXIS_REF? ,   Slave:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   CombineMode:= ?INT? ,   GearRatioNumeratorM1:= ?DINT? ,   GearRatioDenominatorM1:= ?DWORD? ,   GearRatioNumeratorM2:= ?DINT? ,   GearRatioDenominatorM2:= ?DWORD? ,   MasterValueSourceM1:= ?INT? ,   MasterValueSourceM2:= ?INT? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   InSync=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name          | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                      |
|--------------|---------------|-----------|----------|-------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Master1      | Master axis 1 | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>☞ Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |
| Master2      | Master axis 2 | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>☞ Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |
| Slave        | Slave axis    | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>☞ Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

## Input variable

| Input variable         | Name                                  | Data type             | Input                                                  | Valid range               | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------|---------------------------------------|-----------------------|--------------------------------------------------------|---------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute                | Execution command                     | BOOL                  | At start                                               | TRUE, FALSE               | FALSE         | When this variable is set to TRUE, MC_CombineAxes (Addition/Subtraction Positioning) is executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| ContinuousUpdate       | Continuous update                     | BOOL                  | At start                                               | TRUE, FALSE               | FALSE         | Whether to enable or disable continuous change of Addition/subtraction method selection (CombineMode), Master axis 1 gear ratio numerator (GearRatioNumeratorM1), Master axis 1 gear ratio denominator (GearRatioDenominatorM1), Master axis 2 gear ratio numerator (GearRatioNumeratorM2), and Master axis 2 gear ratio denominator (GearRatioDenominatorM2) is set.<br><ul style="list-style-type: none"> <li>• FALSE: Disabled</li> <li>• TRUE: Enabled</li> </ul>                                                                                    |
| CombineMode            | Addition/subtraction method selection | INT (MC_COMBINE_MODE) | At start/Retrigger possible/Continuous update possible | 0, 1                      | 1             | A method used to combine the movement amounts of Master axis 1 (Master1) and Master axis 2 (Master2) is set.<br><ul style="list-style-type: none"> <li>• 0: Add positions of 2 input axes (mcAddAxes)</li> <li>• 1: Subtract positions of 2 input axes (mcSubAxes)</li> </ul> For details, refer to the following.<br> Page 1839 Addition/subtraction method selection (CombineMode)                                                                                  |
| GearRatioNumeratorM1   | Master axis 1 gear ratio numerator    | DINT                  | At start/Retrigger possible/Continuous update possible | -2147483648 to 2147483647 | 1             | The numerator value of Master axis 1 (Master1) is set.<br>For details, refer to the following.<br> Page 1840 Master axis 1 gear ratio numerator (GearRatioNumeratorM1)/Master axis 1 gear ratio denominator (GearRatioDenominatorM1)                                                                                                                                                                                                                                 |
| GearRatioDenominatorM1 | Master axis 1 gear ratio denominator  | DWORD(UDINT)          | At start/Retrigger possible/Continuous update possible | 1 to 2147483647           | 1             | The denominator value of Master axis 1 (Master1) is set.<br>For details, refer to the following.<br> Page 1840 Master axis 1 gear ratio numerator (GearRatioNumeratorM1)/Master axis 1 gear ratio denominator (GearRatioDenominatorM1)                                                                                                                                                                                                                              |
| GearRatioNumeratorM2   | Master axis 2 gear ratio numerator    | DINT                  | At start/Retrigger possible/Continuous update possible | -2147483648 to 2147483647 | 1             | The numerator value of Master axis 2 (Master2) is set.<br>For details, refer to the following.<br> Page 1840 Master axis 2 gear ratio numerator (GearRatioNumeratorM2)/Master axis 2 gear ratio denominator (GearRatioDenominatorM2)                                                                                                                                                                                                                                |
| GearRatioDenominatorM2 | Master axis 2 gear ratio denominator  | DWORD(UDINT)          | At start/Retrigger possible/Continuous update possible | 1 to 2147483647           | 1             | The denominator value of Master axis 2 (Master2) is set.<br>For details, refer to the following.<br> Page 1840 Master axis 2 gear ratio numerator (GearRatioNumeratorM2)/Master axis 2 gear ratio denominator (GearRatioDenominatorM2)                                                                                                                                                                                                                              |
| MasterValueSourceM1    | Master axis 1 data source selection   | INT (MC_SOURCE)       | At start                                               | 1, 2, 101, 102            | 1             | The data source of Master axis 1 (Master1) is set.<br><ul style="list-style-type: none"> <li>• 1: Set value (mcSetValue)</li> <li>• 2: Actual value (mcActualValue)</li> <li>• 101: Latest set value (mcLatestSetValue)</li> <li>• 102: Latest actual value (mcLatestActualValue)</li> </ul> For details, refer to the following.<br> Page 1841 Master axis 1 data source selection (MasterValueSourceM1)/Master axis 2 data source selection (MasterValueSourceM2) |

| Input variable      | Name                                | Data type            | Input    | Valid range    | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------|-------------------------------------|----------------------|----------|----------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MasterValueSourceM2 | Master axis 2 data source selection | INT (MC_SOURCE)      | At start | 1, 2, 101, 102 | 1             | The data source of Master axis 2 (Master2) is set.<br><ul style="list-style-type: none"> <li>• 1: Set value (mcSetValue)</li> <li>• 2: Actual value (mcActualValue)</li> <li>• 101: Latest set value (mcLatestSetValue)</li> <li>• 102: Latest actual value (mcLatestActualValue)</li> </ul> For details, refer to the following.<br> Page 1841 Master axis 1 data source selection (MasterValueSourceM1)/Master axis 2 data source selection (MasterValueSourceM2) |
| BufferMode          | Buffer mode                         | INT (MC_BUFFER_MODE) | At start | 0, 1           | 0             | The buffer mode is set.<br><ul style="list-style-type: none"> <li>• 0: Aborting (mcAborting)</li> <li>• 1: Buffered (mcBuffered)</li> </ul> For details, refer to the following.<br> Page 1842 Buffer mode (BufferMode)                                                                                                                                                                                                                                             |
| Options             | Options                             | DWORD(HEX)           | At start | 00000000H      | 00000000H     | Set "00000000H".<br>* If a value other than "00000000H" is set, Out of Options Range (error code: 1ABBH) occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## ■Output variables

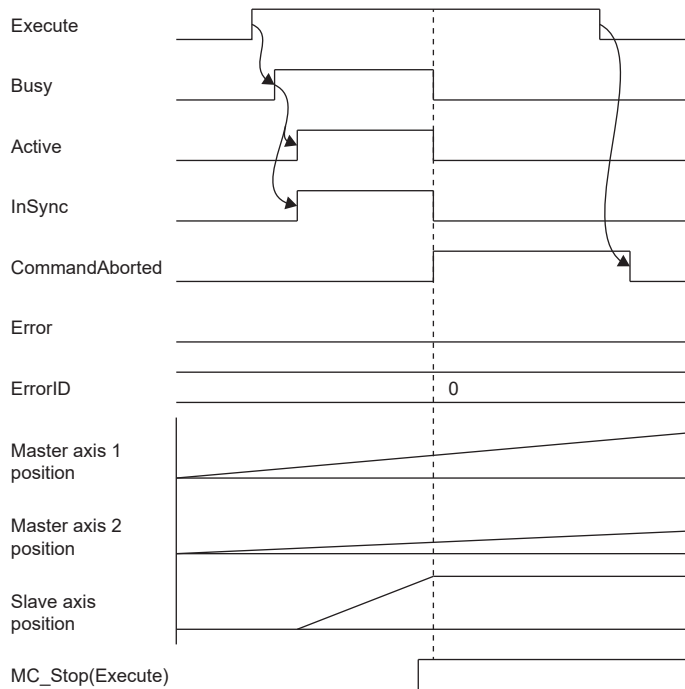
| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                     |
|-----------------|-----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InSync          | In synchronization    | BOOL       | FALSE         | This variable becomes TRUE when Slave axis (Slave) starts synchronization.                                                                                                                                                                      |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MC_CombineAxes (Addition/Subtraction Positioning) is executed.                                                                                                                                                  |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE when Slave axis (Slave) is being controlled.                                                                                                                                                                         |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of MC_CombineAxes (Addition/Subtraction Positioning) is aborted.<br>The variable becomes FALSE when Execution command (Execute) becomes FALSE.                                                        |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |

## Processing details

- This FB sets Addition/subtraction method selection (CombineMode), Master axis 1 gear ratio numerator (GearRatioNumeratorM1), Master axis 1 gear ratio denominator (GearRatioDenominatorM1), Master axis 2 gear ratio numerator (GearRatioNumeratorM2), Master axis 2 gear ratio denominator (GearRatioDenominatorM2), Master axis 1 data source selection (MasterValueSourceM1), Master axis 2 data source selection (MasterValueSourceM2), and Buffer mode (BufferMode), and performs the addition/subtraction positioning.
- To stop the operation, perform MC\_Stop (Forced Stop).
- Combines the movement amounts of Master axis 1 (Master1) and Master axis 2 (Master2). In addition, a gear ratio can be set for each master axis. Combining the movement amounts adds or subtracts the numerical values regardless of the units of Master axis 1 (Master1) and Master axis 2 (Master2).

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

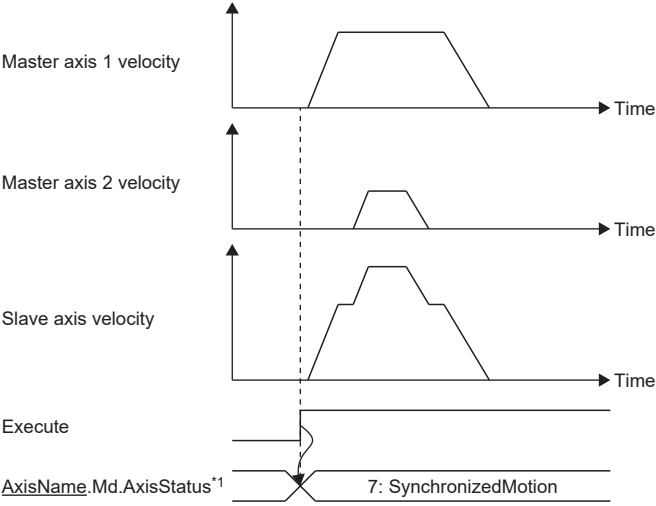
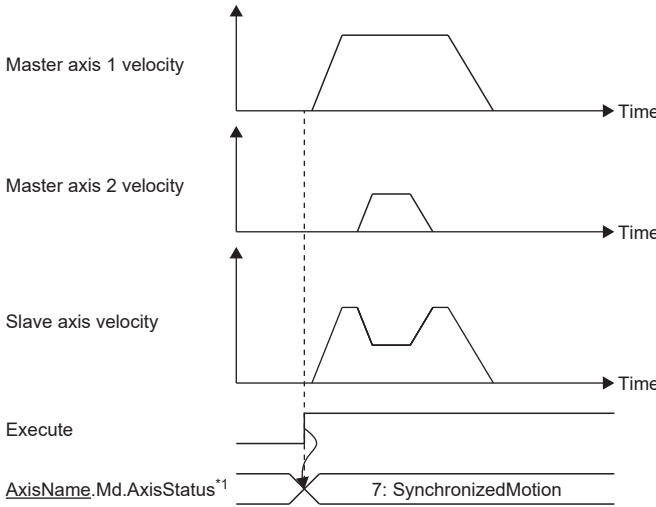
📖 Page 1432 Basic operation of Execution command (Execute) type motion control FBs



## ■ Addition/subtraction method selection (CombineMode)

Sets the method used to combine the movement amounts of Master axis 1 (Master1) and Master axis 2 (Master2).

Combining the movement amounts adds or subtracts the numerical values regardless of the units of Master axis 1 (Master1) and Master axis 2 (Master2).

| Setting value                                        | Description                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Add positions of 2 input axes<br>(mcAddAxes)      | <p>Adds the movement amounts of Master axis 1 (Master1) and Master axis 2 (Master2) and outputs the value.</p> <ul style="list-style-type: none"> <li>• Movement amount of Slave axis (Slave) = Movement amount of Master axis 1 (Master1) + Master axis 2 (Master2)</li> </ul>         |
| 1: Subtract positions of 2 input axes<br>(mcSubAxes) | <p>Subtracts the movement amount of Master axis 2 (Master2) from Master axis 1 (Master1) and outputs the value.</p> <ul style="list-style-type: none"> <li>• Movement amount of Slave axis (Slave) = Movement amount of Master axis 1 (Master1) - Master axis 2 (Master2)</li> </ul>  |

\*1 Axis status of Slave axis (Slave)

### ■ Master axis 1 gear ratio numerator (GearRatioNumeratorM1)/Master axis 1 gear ratio denominator (GearRatioDenominatorM1)

Master axis 1 gear ratio numerator (GearRatioNumeratorM1) and Master axis 1 gear ratio denominator (GearRatioDenominatorM1) are set together.

Master axis 1 gear ratio numerator (GearRatioNumeratorM1) sets the numerator value used when converting and combining the movement amount of Master axis 1 (Master1).

Master axis 1 gear ratio denominator (GearRatioDenominatorM1) sets the denominator value used when converting and combining the movement amount of Master axis 1 (Master1).

The movement amount is converted as shown below.

$$\text{Movement amount of the master axis 1 (Master1) after conversion} = \text{movement amount of the master axis 1 (Master1) before conversion} \times \frac{\text{Master axis 1 gear ratio numerator (GearRatioNumeratorM1)}}{\text{Master axis 1 gear ratio denominator (GearRatioDenominatorM1)}}$$

- Set a positive value in Master axis 1 gear ratio denominator (GearRatioDenominatorM1).
- The movement amount can be reversed and combined by setting a negative value in Master axis 1 gear ratio numerator (GearRatioNumeratorM1).
- To combine and have the movement amount of Master axis 1 (Master1) be "0" after conversion, set "0" as the setting value in Master axis 1 gear ratio numerator (GearRatioNumeratorM1).

### ■ Master axis 2 gear ratio numerator (GearRatioNumeratorM2)/Master axis 2 gear ratio denominator (GearRatioDenominatorM2)

Master axis 2 gear ratio numerator (GearRatioNumeratorM2) and Master axis 2 gear ratio denominator (GearRatioDenominatorM2) are set together.

Master axis 2 gear ratio numerator (GearRatioNumeratorM2) sets the numerator value used when converting and combining the movement amount of Master axis 2 (Master2).

Master axis 2 gear ratio denominator (GearRatioDenominatorM2) sets the denominator value used when converting and combining the movement amount of Master axis 2 (Master2).

The movement amount is converted as shown below.

$$\text{Movement amount of the master axis 2 (Master2) after conversion} = \text{movement amount of the master axis 2 (Master2) before conversion} \times \frac{\text{Master axis 2 gear ratio numerator (GearRatioNumeratorM2)}}{\text{Master axis 2 gear ratio denominator (GearRatioDenominatorM2)}}$$

- Set a positive value in Master axis 2 gear ratio denominator (GearRatioDenominatorM2).
- The movement amount can be reversed and combined by setting a negative value in Master axis 2 gear ratio numerator (GearRatioNumeratorM2).
- To combine and have the movement amount of Master axis 2 (Master2) be "0" after conversion, set "0" as the setting value in Master axis 2 gear ratio numerator (GearRatioNumeratorM2).

## ■ Master axis 1 data source selection (MasterValueSourceM1)/Master axis 2 data source selection (MasterValueSourceM2)

Slave axis (Slave) sets the position type of Master axis 1 (Master1) or Master axis 2 (Master2) that will execute single axis synchronous control.

The operation may differ depending on the execution order of the FBs or if the operation cycles of Master axis 1 (Master1) or Master axis 2 (Master2) and Slave axis (Slave) are different.

Operates with the same value as the set value when specifying Actual value in Master axis 1 data source selection (MasterValueSourceM1) or Master axis 2 data source selection (MasterValueSourceM2) while an axis type other than real axis is set in Master axis 1 (Master1) or Master axis 2 (Master2).

| Setting value                                  | Description                                                                     |
|------------------------------------------------|---------------------------------------------------------------------------------|
| 1: Set value (mcSetValue)                      | Uses the commanded position of the master axis in the previous operation cycle. |
| 2: Actual value (mcActualValue)                | Uses the actual position of the master axis in the previous operation cycle.    |
| 101: Latest set value (mcLatestSetValue)       | Uses the commanded position of the master axis in the current operation cycle.  |
| 102: Latest actual value (mcLatestActualValue) | Uses the actual position of the master axis in the current operation cycle.     |

### Point

When Master axis 1 data source selection (MasterValueSourceM1) or Master axis 2 data source selection (MasterValueSourceM2) are set to "1: Set value (mcSetValue)" or "101: Latest set value (mcLatestSetValue)" and the master axis becomes servo OFF by a servo alarm or forced stop, the amount of the value change may be too large. This can be prevented by setting Master axis 1 data source selection (MasterValueSourceM1) or Master axis 2 data source selection (MasterValueSourceM2) to "2: Actual value (mcActualValue)" or "102: Latest actual value (mcLatestActualValue)".

■Buffer mode (BufferMode)

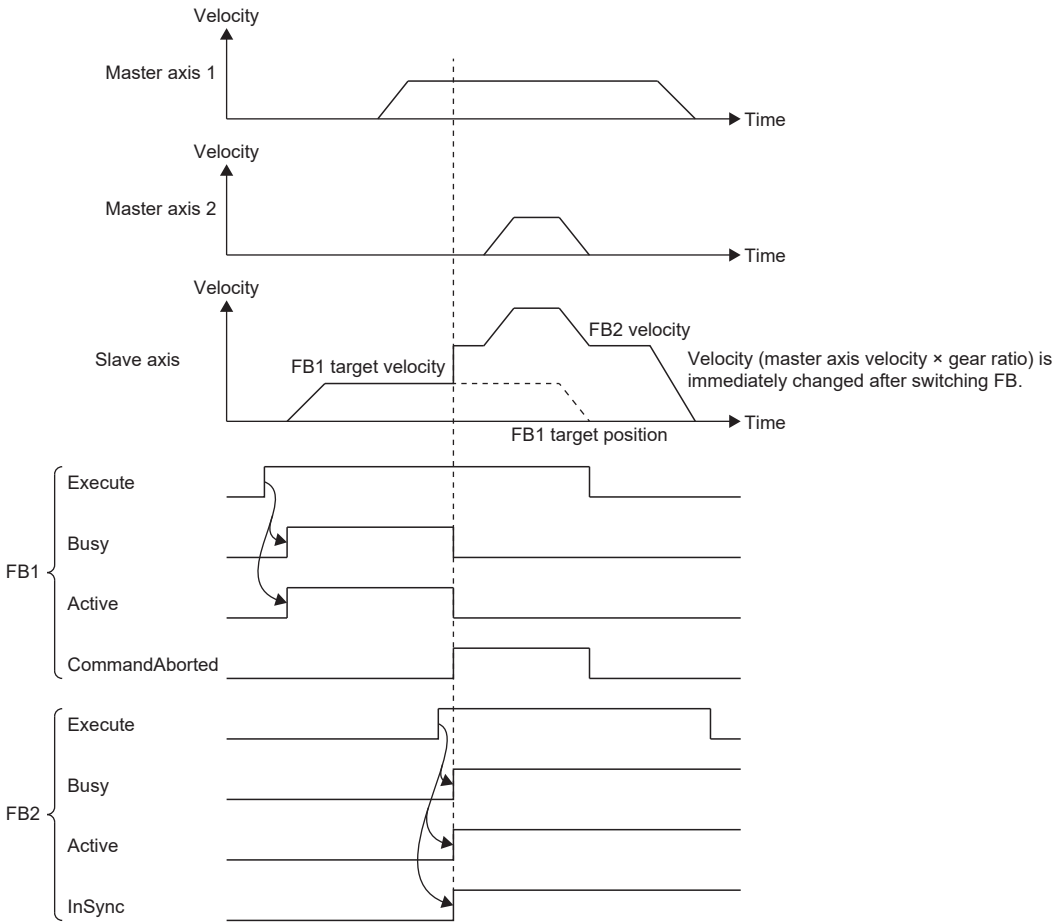
Sets the operation used to perform multiple start (buffer mode).  
The following buffer modes are settable in MC\_CombineAxes (Addition/Subtraction Positioning).  
The velocity of MC\_CombineAxes (Addition/Subtraction Positioning) follows the synchronizing FB (master axis) and changes immediately based on the master axis velocity and the set gear data when the FB is switched.

| Setting value            | Description                                                                                                                                                                                                                                       |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting) | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                       |
| 1: Buffered (mcBuffered) | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB. |

Ex.

When linked start FB2 (Slave axis (Slave): MC\_CombineAxes (Addition/Subtraction Positioning)) has Buffer mode (BufferMode) set to "0: Aborting (mcAborting)" while FB1 is being executed

- When Addition/subtraction method selection (CombineMode) is set to "0: Add positions of 2 input axes (mcAddAxes)"



Velocity of FB2 occurs after In synchronization (InSync) becomes TRUE.

Point

For details on multiple start (buffer mode), refer to the following.  
📖 User's manual for the controller used

## Program example

The following is a program example. The addition/subtraction positioning start command (bCombineAxesStart) is set to TRUE, and positioning of the slave axis (Axis0001) is performed using the added/subtracted movement amount of the two master axes, Axis 2 (Axis0002) of the JOG 1 FB and Axis 3 (Axis0003) of the JOG 1 FB.

- Settings

| Item                            |              | Setting value  |                |
|---------------------------------|--------------|----------------|----------------|
|                                 |              | Data for JOG 1 | Data for JOG 2 |
| Data settings for JOG operation | Velocity     | 1000.0         | 500.0          |
|                                 | Acceleration | 5000.0         | 5000.0         |
|                                 | Deceleration | 5000.0         | 5000.0         |
|                                 | Jerk         | 0.0            | 0.0            |

## ■Axes

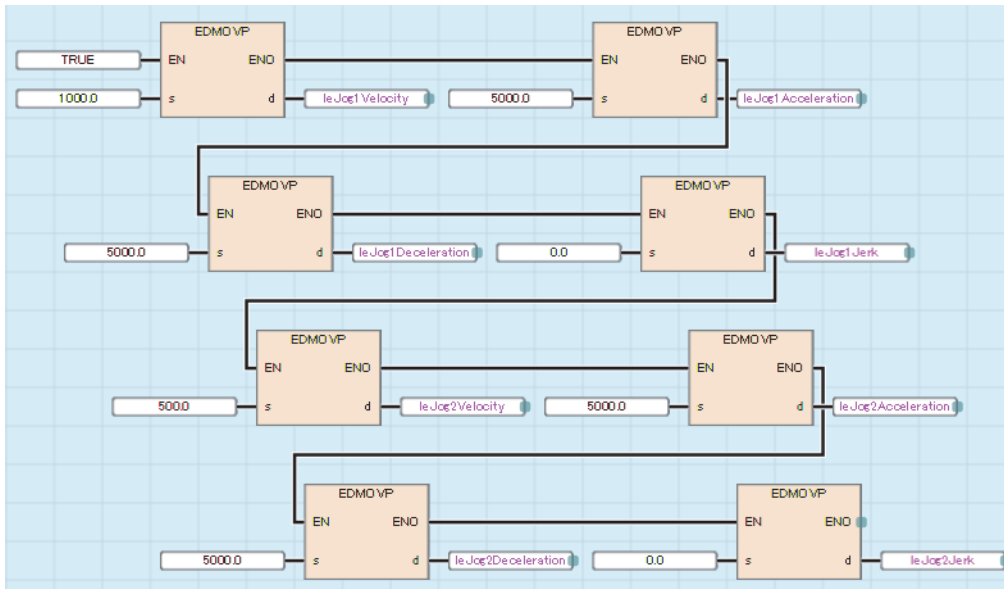
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |
| 2        | Axis0002   | AXIS_REF  | Axis 2  |
| 3        | Axis0003   | AXIS_REF  | Axis 3  |

## ■Labels used

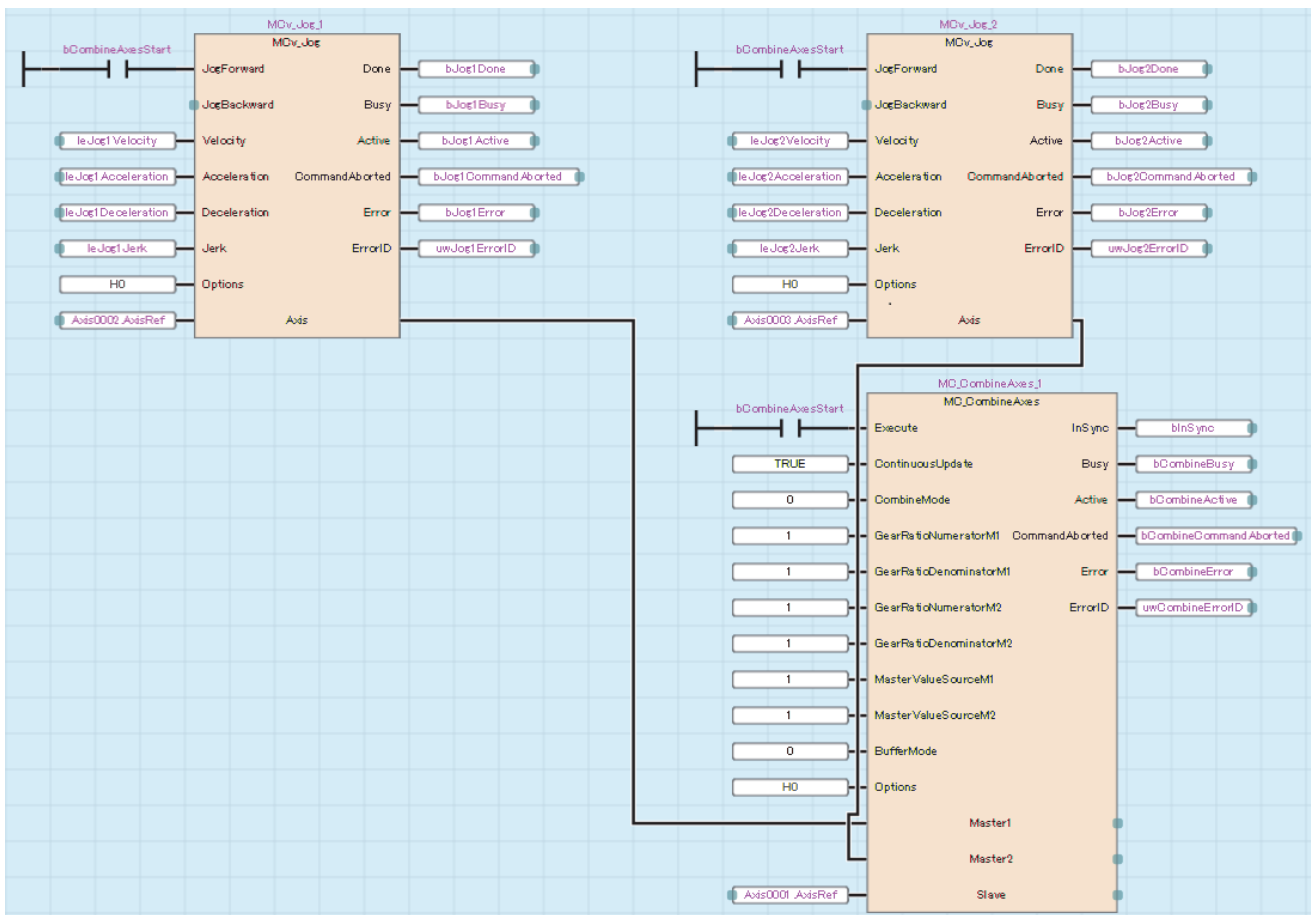
| Label name             | Data type                           | Comment                                        |
|------------------------|-------------------------------------|------------------------------------------------|
| MC_CombineAxes_1       | MC_CombineAxes                      | Addition/Subtraction Positioning FB            |
| bCombineAxesStart      | Bit                                 | Addition/subtraction positioning start command |
| bInSync                | Bit                                 | In synchronization                             |
| bCombineBusy           | Bit                                 | Executing                                      |
| bCombineActive         | Bit                                 | Controlling                                    |
| bCombineCommandAborted | Bit                                 | Abortion of execution                          |
| bCombineError          | Bit                                 | Error                                          |
| uwCombineErrorID       | Word [unsigned]/bit string [16-bit] | Error code                                     |
| MCv_Jog_1              | MCv_Jog                             | JOG 1 FB                                       |
| leJog1Velocity         | Double-precision real number        | JOG velocity                                   |
| leJog1Acceleration     | Double-precision real number        | JOG acceleration                               |
| leJog1Deceleration     | Double-precision real number        | JOG deceleration                               |
| leJog1Jerk             | Double-precision real number        | JOG jerk                                       |
| bJog1Done              | Bit                                 | Execution completion                           |
| bJog1Busy              | Bit                                 | Executing                                      |
| bJog1Active            | Bit                                 | Controlling                                    |
| bJog1CommandAborted    | Bit                                 | Abortion of execution                          |
| bJog1Error             | Bit                                 | Error                                          |
| uwJog1ErrorID          | Word [unsigned]/bit string [16-bit] | Error code                                     |
| MCv_Jog_2              | MCv_Jog                             | JOG 2 FB                                       |
| leJog2Velocity         | Double-precision real number        | JOG velocity                                   |
| leJog2Acceleration     | Double-precision real number        | JOG acceleration                               |
| leJog2Deceleration     | Double-precision real number        | JOG deceleration                               |
| leJog2Jerk             | Double-precision real number        | JOG jerk                                       |
| bJog2Done              | Bit                                 | Execution completion                           |
| bJog2Busy              | Bit                                 | Executing                                      |
| bJog2Active            | Bit                                 | Controlling                                    |
| bJog2CommandAborted    | Bit                                 | Abortion of execution                          |
| bJog2Error             | Bit                                 | Error                                          |
| uwJog2ErrorID          | Word [unsigned]/bit string [16-bit] | Error code                                     |

## ■ FBD/LD program

- Data settings for JOG operation



- JOG 1/JOG 2/Addition/Subtraction Positioning



## ■ST program

```
//-----Data settings for JOG operation-----
leJog1Velocity:= 1000.0;
leJog1Acceleration:= 5000.0;
leJog1Deceleration:= 5000.0;
leJog1Jerk:= 0.0;
leJog2Velocity:= 500.0;
leJog2Acceleration:= 5000.0;
leJog2Deceleration:= 5000.0;
leJog2Jerk:= 0.0;

//-----JOG 1-----
MCv_Jog_1(
  Axis:= Axis0002.AxisRef ,
  JogForward:= bCombineAxesStart ,
  Velocity:= leJog1Velocity ,
  Acceleration:= leJog1Acceleration ,
  Deceleration:= leJog1Deceleration ,
  Jerk:= leJog1Jerk ,
  Options:= H00000000 ,
  Done=> bJog1Done ,
  Busy=> bJog1Busy ,
  Active=> bJog1Active ,
  CommandAborted=> bJog1CommandAborted ,
  Error=> bJog1Error ,
  ErrorID=> uwJog1ErrorID
);

//-----JOG 2-----
MCv_Jog_2(
  Axis:= Axis0003.AxisRef ,
  JogForward:= bCombineAxesStart ,
  Velocity:= leJog2Velocity ,
  Acceleration:= leJog2Acceleration ,
  Deceleration:= leJog2Deceleration ,
  Jerk:= leJog2Jerk ,
  Options:= H00000000 ,
  Done=> bJog2Done ,
  Busy=> bJog2Busy ,
  Active=> bJog2Active ,
  CommandAborted=> bJog2CommandAborted ,
  Error=> bJog2Error ,
  ErrorID=> uwJog2ErrorID
);

//-----Addition/Subtraction Positioning-----
MC_CombineAxes_1(
  Master1:= Axis0002.AxisRef ,
  Master2:= Axis0003.AxisRef ,
  Slave:= Axis0001.AxisRef ,
  Execute:= bCombineAxesStart ,
  ContinuousUpdate:= TRUE ,
```

```

CombineMode:= MC_COMBINE_MODE__mcAddAxes ,
GearRatioNumeratorM1:= 1 ,
GearRatioDenominatorM1:= 1 ,
GearRatioNumeratorM2:= 1 ,
GearRatioDenominatorM2:= 1 ,
MasterValueSourceM1:= MC_SOURCE__mcSetValue ,
MasterValueSourceM2:= MC_SOURCE__mcSetValue ,
BufferMode:= MC_BUFFER_MODE__mcAborting ,
Options:= H00000000 ,
InSync=> bInSync ,
Busy=> bCombineBusy ,
Active=> bCombineActive ,
CommandAborted=> bCombineCommandAborted ,
Error=> bCombineError ,
ErrorID=> uwCombineErrorID
);

```



# 46.17 Backlash Compensation Filter

46

## MCv\_BacklashCompensationFilter

This FB performs filter processing that compensates the backlash amount in the machine system according to the movement direction.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MCv_BacklashCompensationFilter(   Master:= ?AXIS_REF? ,   Slave:= ?AXIS_REF? ,   Enable:= ?BOOL? ,   FilterDisable:= ?BOOL? ,   BacklashAmount:= ?LREAL? ,   BacklashDirection:= ?INT? ,   MasterValueSource:= ?INT? ,   Options:= ?DWORD? ,   Valid=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   FilterPool=&gt; ?LREAL? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name        | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|-------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Master       | Master axis | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |
| Slave        | Slave axis  | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable | Name            | Data type | Input    | Valid range             | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------|-----------------|-----------|----------|-------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable         | Enable          | BOOL      | Always   | TRUE, FALSE             | FALSE         | When this variable is set to TRUE, MCv_BacklashCompensationFilter (Backlash Compensation Filter) is executed.                                                                                                                                                                                                                                                                                                                                |
| FilterDisable  | Filter disable  | BOOL      | Always   | TRUE, FALSE             | FALSE         | The filter processing method is set.<br>• FALSE: Operates according to the filter setting.<br>• TRUE: Disables the filter and transmits the Master axis (Master) input to Slave axis (Slave) as it is.<br>* When this variable is set to TRUE, the value of Filter cumulated value (FilterPool) becomes "0" and the disposed value from Filter cumulated value (FilterPool) is stored in Disposed filter cumulated value (PurgedFilterPool). |
| BacklashAmount | Backlash amount | LREAL     | At start | 0.0 to 2500000000.0 [U] | 0.0           | The backlash amount used in the machine system is set.                                                                                                                                                                                                                                                                                                                                                                                       |

| Input variable    | Name                              | Data type          | Input    | Valid range | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------|-----------------------------------|--------------------|----------|-------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BacklashDirection | Backlash compensation direction   | INT (MC_DIRECTION) | At start | 1, 2        | 0             | The backlash compensation direction is set. <ul style="list-style-type: none"> <li>• 1: Positive direction (mcPositiveDirection)</li> <li>• 2: Negative direction (mcNegativeDirection)</li> </ul> * If this setting is omitted, Out of Backlash Compensation Direction Range (error code: 1BC0H) occurs.<br>For details, refer to the following.<br> Page 1852 Backlash compensation direction (BacklashDirection) |
| MasterValueSource | Master axis data source selection | INT (MC_SOURCE)    | At start | 1, 101      | 1             | The data source of Master axis (Master) is set. <ul style="list-style-type: none"> <li>• 1: Set value (mcSetValue)</li> <li>• 101: Latest set value (mcLatestSetValue)</li> </ul> For details, refer to the following.<br> Page 1852 Master axis data source selection (MasterValueSource)                                                                                                                          |
| Options           | Options                           | DWORD(HEX)         | At start | 0000000H    | 0000000H      | The function options are set.<br>For details, refer to the following.<br> Page 1853 Options (Options)                                                                                                                                                                                                                                                                                                               |

## ■Output variables

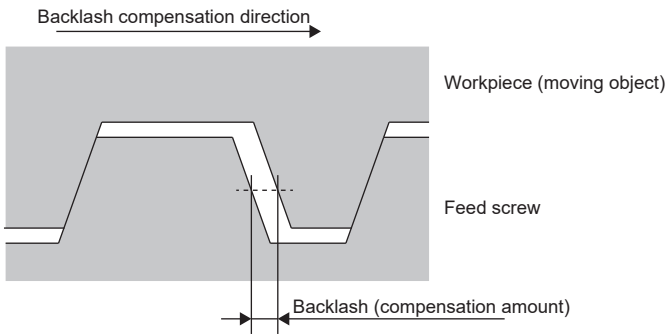
| Output variable | Name                   | Data type  | Default value | Description                                                                                                                                                                                                                                                     |
|-----------------|------------------------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Valid           | Output value valid     | BOOL       | FALSE         | This variable becomes TRUE when the output value is valid.                                                                                                                                                                                                      |
| Busy            | Executing              | BOOL       | FALSE         | This variable becomes TRUE when MCv_BacklashCompensationFilter (Backlash Compensation Filter) is executed.                                                                                                                                                      |
| Active          | Controlling            | BOOL       | FALSE         | This variable becomes TRUE when MCv_BacklashCompensationFilter (Backlash Compensation Filter) is controlling the axis.                                                                                                                                          |
| CommandAborted  | Abortion of execution  | BOOL       | FALSE         | This variable becomes TRUE when execution of MCv_BacklashCompensationFilter (Backlash Compensation Filter) is aborted.                                                                                                                                          |
| Error           | Error                  | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                |
| ErrorID         | Error code             | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                 |
| FilterPool      | Filter cumulated value | LREAL      | 0.0           | This variable outputs the slave axis movement amount cumulated in filter processing.<br>When the backlash filter is used, the compensation amount transmitted to the slave axis is the reversed positive/negative value in Filter cumulated value (FilterPool). |

## ■Public variables

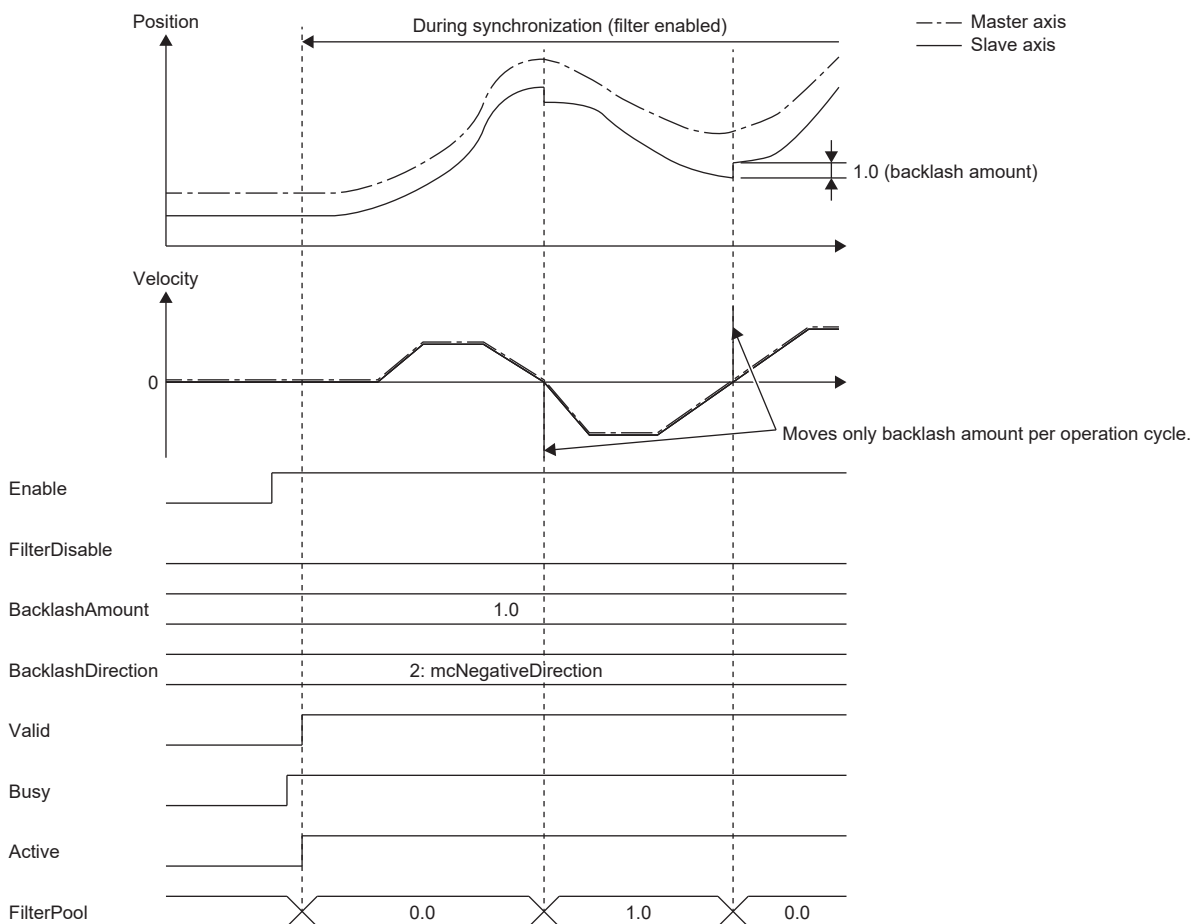
| Public variable  | Name                            | Data type | Default value | Description                                                                                                                                                                                                                                                     |
|------------------|---------------------------------|-----------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PurgedFilterPool | Disposed filter cumulated value | LREAL     | 0.0           | When Filter disable (FilterDisable) is set to TRUE, this variable stores the disposed value from Filter cumulated value (FilterPool).<br>Disposed filter cumulated value (PurgedFilterPool) is not cumulative.<br>The value is cleared to 0 at start of the FB. |

## Processing details

- This FB compensates for the backlash amount in the machine system.

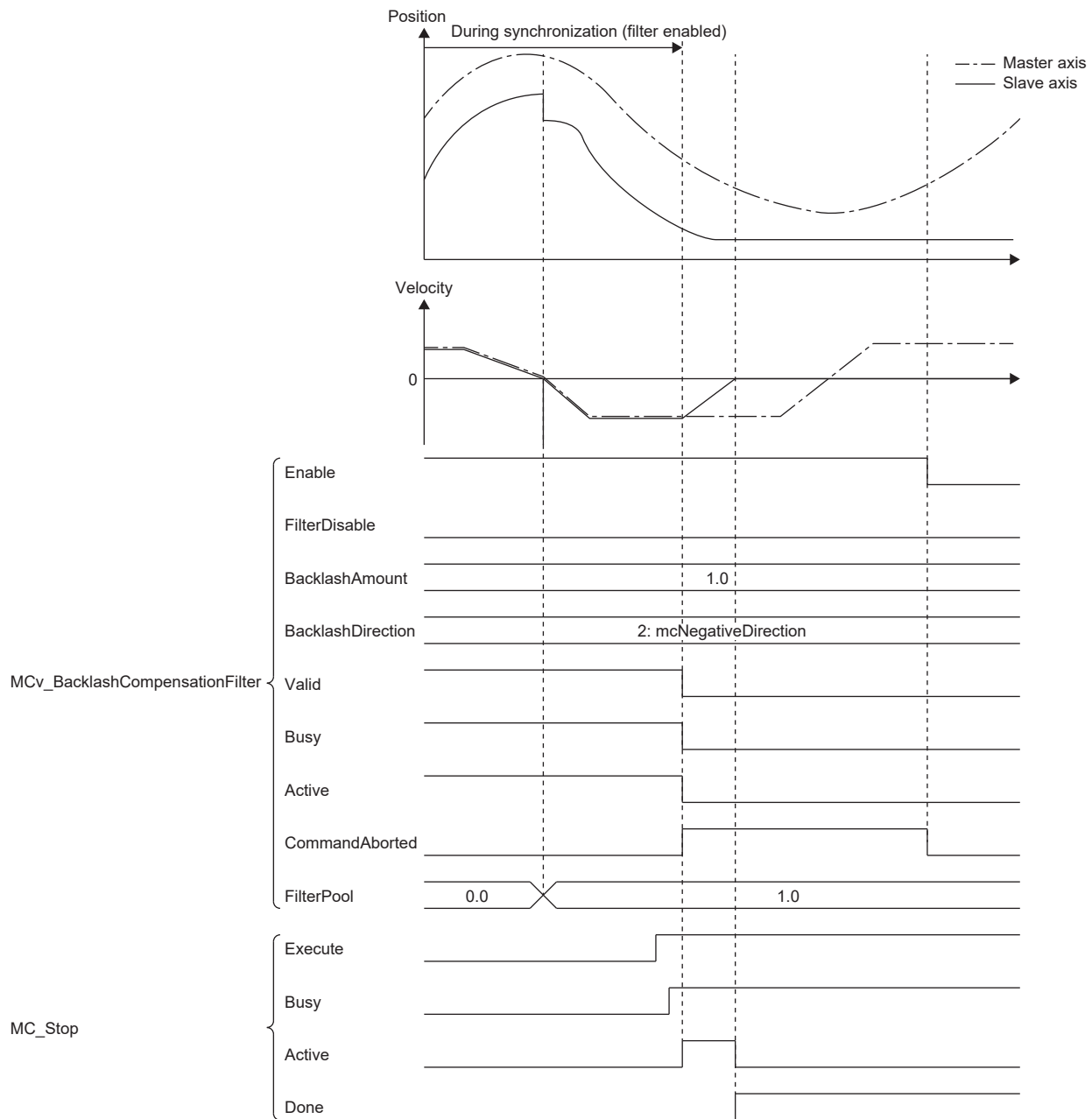


- When the movement direction of Master axis (Master) is the same as Backlash compensation direction (BacklashDirection), Slave axis (Slave) synchronizes to the position equivalent to the Master axis (Master) current position shifted in the Backlash direction (BacklashDirection) by the value of Backlash amount (BacklashAmount). When the movement direction of Master axis (Master) is the reverse of Backlash compensation direction (BacklashDirection), Slave axis (Slave) synchronizes to the Master axis (Master) current position. Whenever the Master axis (Master) movement direction changes, backlash compensation is performed with the Slave axis (Slave) extra movement amount limited to only the value of Backlash amount (BacklashAmount).



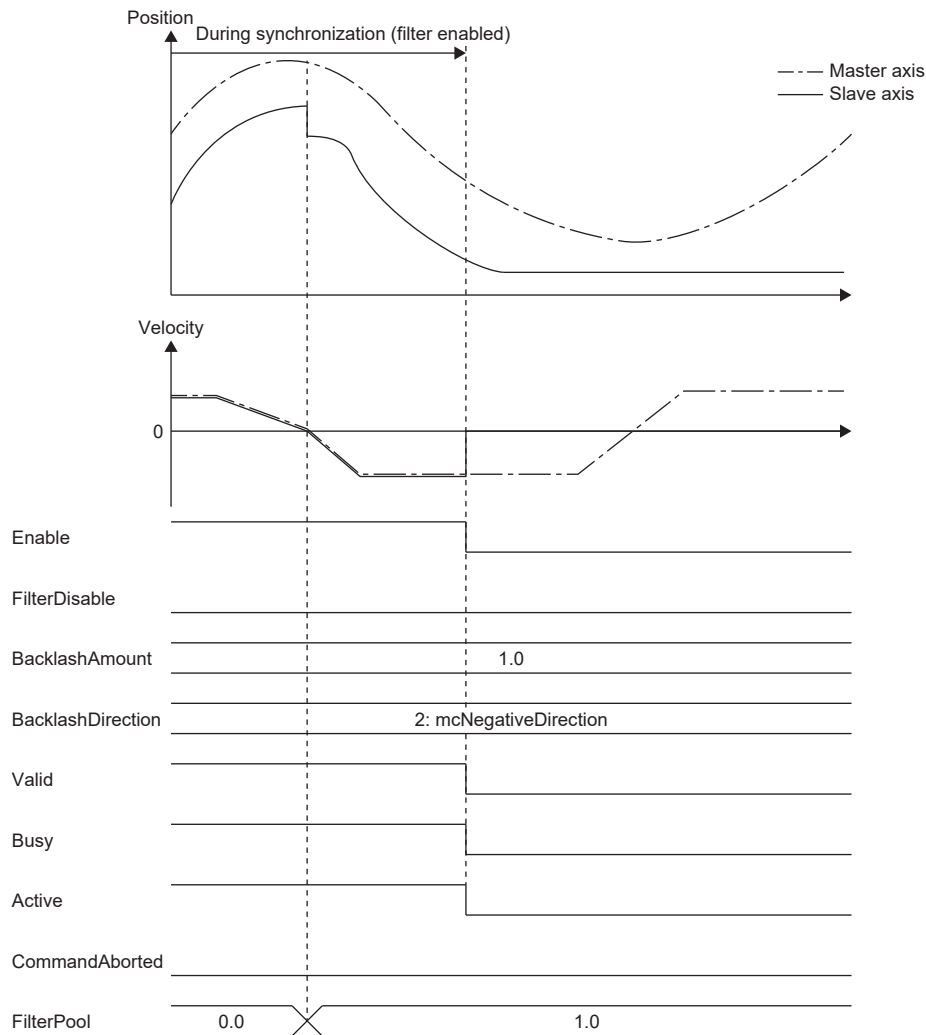
- This section describes the stop operation specific to the backlash compensation filter.

When the stop factor occurs on Slave axis (Slave), Slave axis (Slave) starts the stop operation from the synchronous position. The compensated movement amount (the value from Filter cumulated value (FilterPool)) will not be restored to its original value.



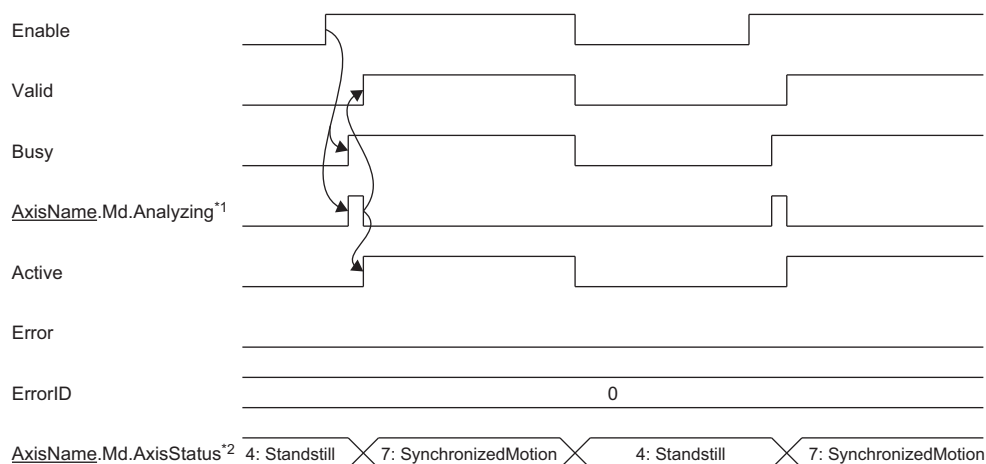
- Operation at filter disabled (at Enable (Enable) falling edge)

Slave axis (Slave) stops immediately at the synchronous position upon reaching the Enable (Enable) falling edge. The compensated movement amount (the value from Filter cumulated value (FilterPool)) will not be restored to its original value.



### ■ Timing chart

- When the processing is completed successfully



\*1 "Analyzing" of Slave axis (Slave).

\*2 Axis status of Slave axis (Slave)

- When the processing is completed with an error

For the timing chart, refer to the following.

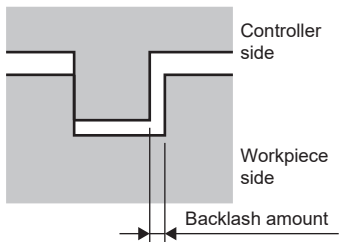
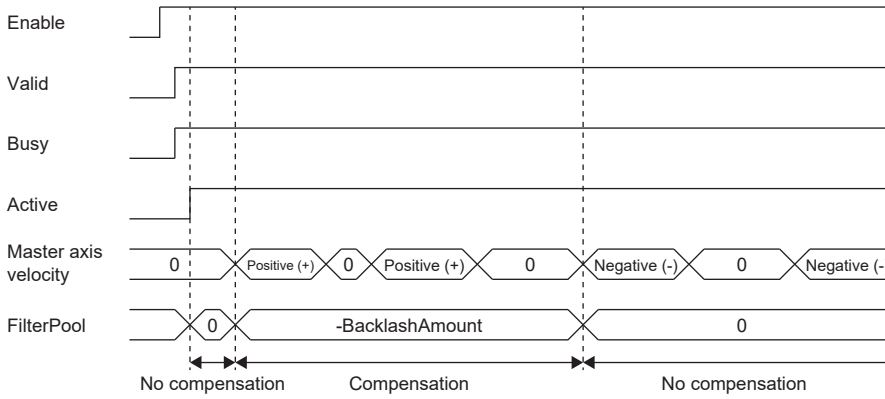
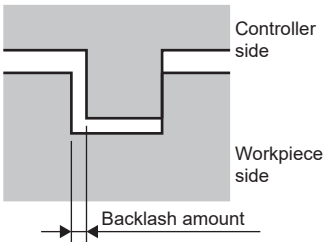
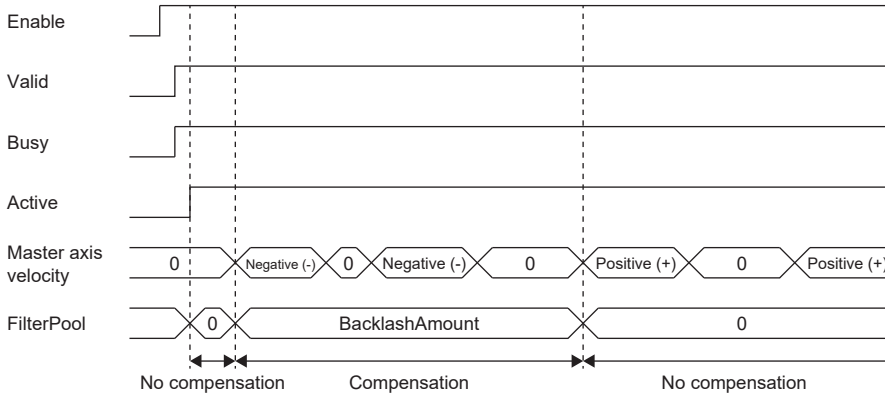
📖 Page 1435 Basic operation of Enable (Enable) type motion control FBs

## ■ Backlash compensation direction (BacklashDirection)

Sets the backlash compensation direction.

Outputs the compensation amount to Slave axis (Slave) when the Master axis (Master) movement direction is the value of Backlash compensation direction (BacklashDirection).

When the backlash compensation filter is enabled (when starting the FB with Filter disable (FilterDisable) set to FALSE, or when Filter disable (FilterDisable) reaches the trailing edge during execution), compensates to the address increasing direction of the Master axis (Master) set position so that the backlash status of the machine system is in the following relation.

| Setting value                                                                                                                                                                                     | Description                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1: Positive direction (mcPositiveDirection)</b><br>The address increasing direction of the set position<br>   | <p>When the movement direction of Master axis (Master) is the positive direction, Slave axis (Slave) synchronizes to the position equivalent to the Master axis (Master) current position shifted in the positive direction by the value of Backlash amount (BacklashAmount).</p>    |
| <b>2: Negative direction (mcNegativeDirection)</b><br>The address increasing direction of the set position<br> | <p>When the movement direction of Master axis (Master) is the negative direction, Slave axis (Slave) synchronizes to the position equivalent to the Master axis (Master) current position shifted in the negative direction by the value of Backlash amount (BacklashAmount).</p>  |

## ■ Master axis data source selection (MasterValueSource)

Slave axis (Slave) sets the position type of Master axis (Master) that will execute single axis synchronous control.

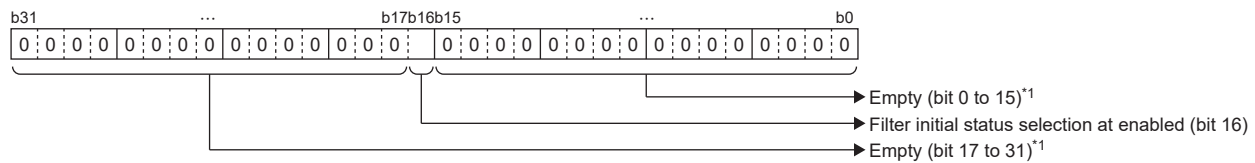
The operation may differ depending on the execution order of the FBs or if the operation cycles of Master axis (Master) and Slave axis (Slave) are different.

| Setting value                            | Description                                                                     |
|------------------------------------------|---------------------------------------------------------------------------------|
| 1: Set value (mcSetValue)                | Uses the commanded position of the master axis in the previous operation cycle. |
| 101: Latest set value (mcLatestSetValue) | Uses the commanded position of the master axis in the current operation cycle.  |

## Options (Options)

The function options for MCv\_Jog (JOG) are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit | Name                                   | Description                                                                                                                                                                                                                                                                                                                                                                                |
|-----|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16  | Enable filter initial status selection | Sets the initial status for when the backlash compensation filter is enabled (when starting the FB with Filter disable (FilterDisable) set to FALSE, or when Filter disable (FilterDisable) reaches the trailing edge during execution).<br>• 0: First compensation<br>*If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs and the function does not start. |

- Enable filter initial status selection (Bit 16)

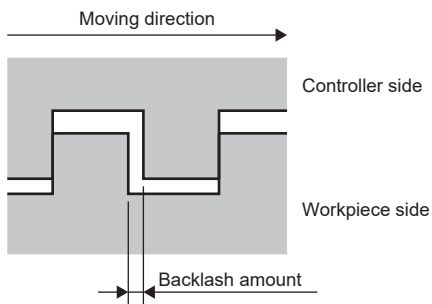
| Setting value         | Description                                                                                                                                                                                                                                                                            |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: First compensation | Regardless of the Master axis (Master) current direction when the filter is enabled, starts filter operation assuming that the position relation of the Master axis (Master) current position and the Slave axis (Slave) current position do not have the backlash compensation added. |

## Procedure for enabling the backlash compensation filter

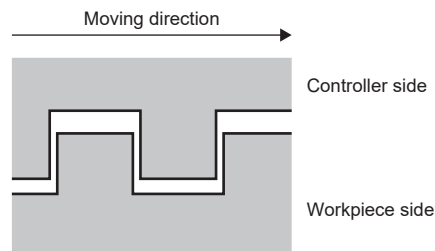
This section describes the procedure for enabling the backlash compensation filter and a usage example. Perform this procedure after the machine position is established by homing, or when restarting the backlash compensation filter after cancelling it midway.

1. Move the real drive axis by operations such as homing or JOG operation, and maintain the status so that the backlash of the machine system is generated in only one direction as shown in the correct example below.

■Correct example



■Incorrect example



2. Match the Master axis (Master) set position with the real drive axis set position by using the current position change, etc.
3. Set Backlash compensation direction (BacklashDirection) so that it is the reverse direction of the direction that the real drive axis was moved to in Step 1., then start the backlash compensation filter. In addition, start any back part function blocks that are present.

## Precautions

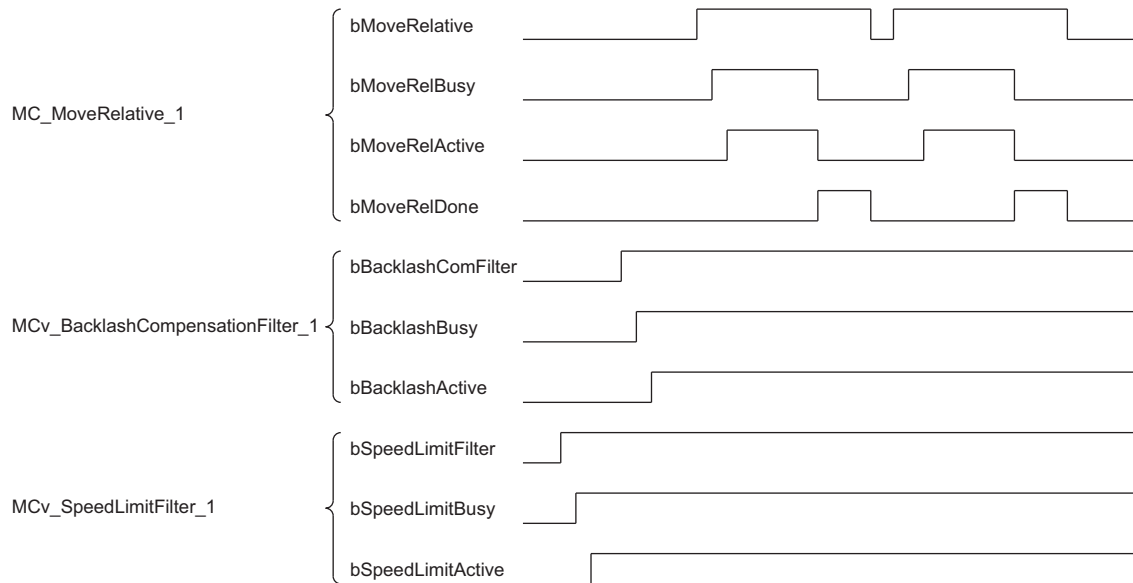
- The backlash compensation is a function which the command direction and the backlash status should not change from the external force and other factors. Correct compensation will not be performed when this function is used in the following cases.
  - A machine that has external force constantly applied in one direction, such as a vertical axis
  - A mechanism (such as rack and pinion mechanism) in which the backlash amount changes depending on the machine position
- When the Master axis (Master) movement direction changes, Slave axis (Slave) moves only the value of Backlash amount (BacklashAmount) for one operation cycle. Depending on the value, it may exceed the command frequency that the speed limit value and the driver unit can accept, so connect the speed limit filter or the smoothing filter to the backlash compensation filter back part.
- The Slave axis (Slave) current position (such as set position, machine feed position, etc.) will be the position to which the value of Backlash amount (BacklashAmount) compensation is added. Backlash amount (BacklashAmount) compensation will not be added to the Master axis (Master) current position.
- If Filter disable (FilterDisable) is switched during operation, the Slave axis (Slave) velocity may change rapidly.
- After enabling the command filter, when the Master axis (Master) command is not transmitted to Slave axis (Slave) or the back part synchronous control FB because the stop factor occurred on Slave axis (Slave), the synchronous position relation deviates. Before enabling the command filter again, execute the synchronous positioning as needed.



## Program example

The following is a program example. The speed limit filter is connected to the output stage of the backlash compensation filter and the filter processing is performed.

### • Timing chart



### • Settings

| Item                                              |                                | Setting value |
|---------------------------------------------------|--------------------------------|---------------|
| Backlash amount                                   |                                | 1.0           |
| Data settings for single axis positioning         | Movement amount                | 1000.0        |
|                                                   | Velocity                       | 20.0          |
|                                                   | Acceleration                   | 300.0         |
|                                                   | Deceleration                   | 300.0         |
|                                                   | Jerk                           | 0.0           |
| Positive direction/negative direction limit value | Positive direction limit value | 100.0         |
|                                                   | Negative direction limit value | 100.0         |

### ■ Axes

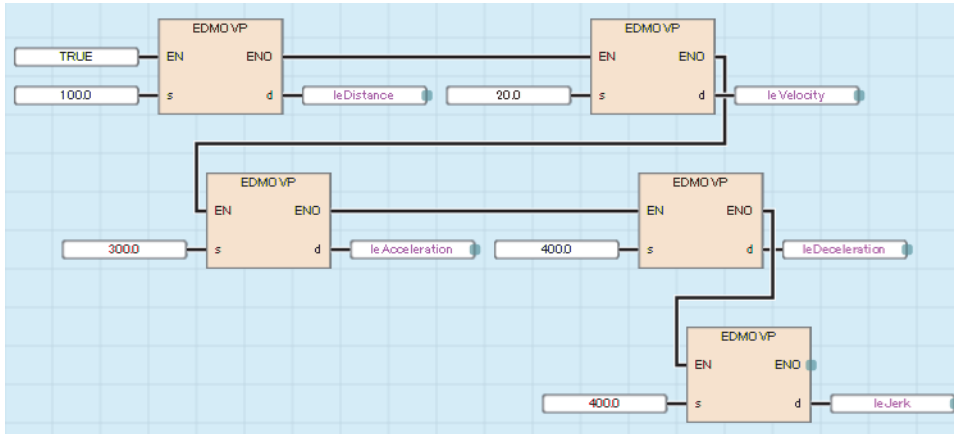
| Axis No. | Label name      | Data type | Comment                     |
|----------|-----------------|-----------|-----------------------------|
| 1        | VirtualAxis0001 | AXIS_REF  | Axis 1 (Virtual drive axis) |
| 2        | VirtualAxis0002 | AXIS_REF  | Axis 2 (Virtual drive axis) |
| 3        | Axis0003        | AXIS_REF  | Axis 3 (Real drive axis)    |

## ■Labels used

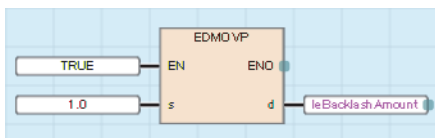
| Label name                       | Data type                           | Comment                                      |
|----------------------------------|-------------------------------------|----------------------------------------------|
| MC_MoveRelative_1                | MC_MoveRelative                     | Relative Value Positioning FB                |
| bMoveRelative                    | Bit                                 | Single axis relative value positioning start |
| leDistance                       | Double-precision real number        | Movement amount                              |
| leVelocity                       | Double-precision real number        | Velocity                                     |
| leAcceleration                   | Double-precision real number        | Acceleration                                 |
| leDeceleration                   | Double-precision real number        | Deceleration                                 |
| leJerk                           | Double-precision real number        | Jerk                                         |
| bMoveRelDone                     | Bit                                 | Execution completion                         |
| bMoveRelBusy                     | Bit                                 | Executing                                    |
| bMoveRelActive                   | Bit                                 | Controlling                                  |
| bMoveRelCommandAborted           | Bit                                 | Abortion of execution                        |
| bMoveRelError                    | Bit                                 | Error                                        |
| uwMoveRelErrorID                 | Word [unsigned]/bit string [16-bit] | Error code                                   |
| MCv_BacklashCompensationFilter_1 | MCv_BacklashCompensationFilter      | Backlash Compensation Filter FB              |
| bBacklashComFilter               | Bit                                 | Backlash compensation filter command         |
| leBacklashAmount                 | Double-precision real number        | Backlash amount                              |
| bBacklashValid                   | Bit                                 | Output value valid                           |
| bBacklashBusy                    | Bit                                 | Executing                                    |
| bBacklashActive                  | Bit                                 | Controlling                                  |
| bBacklashCommandAborted          | Bit                                 | Abortion of execution                        |
| bBacklashError                   | Bit                                 | Error                                        |
| uwBacklashErrorID                | Word [unsigned]/bit string [16-bit] | Error code                                   |
| leBacklashFilterPool             | Double-precision real number        | Filter cumulated value                       |
| MCv_SpeedLimitFilter_1           | MCv_SpeedLimitFilter                | Speed Limit Filter                           |
| bSpeedLimitFilter                | Bit                                 | Speed limit filter command                   |
| lePositiveLimit                  | Double-precision real number        | Positive direction limit value               |
| leNegativeLimit                  | Double-precision real number        | Negative direction limit value               |
| bSpeedLimitValid                 | Bit                                 | Output value valid                           |
| bSpeedLimitBusy                  | Bit                                 | Executing                                    |
| bSpeedLimitActive                | Bit                                 | Controlling                                  |
| bSpeedLimitCommandAborted        | Bit                                 | Abortion of execution                        |
| bSpeedLimitError                 | Bit                                 | Error                                        |
| uwSpeedLimitErrorID              | Word [unsigned]/bit string [16-bit] | Error code                                   |
| leFilterPool                     | Double-precision real number        | Filter cumulated value                       |

## ■ FBD/LD program

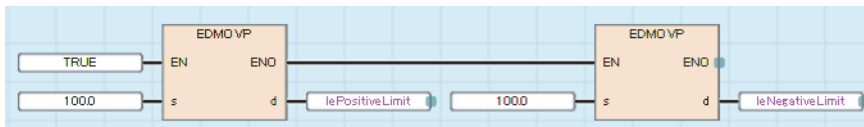
- Data settings for single axis positioning



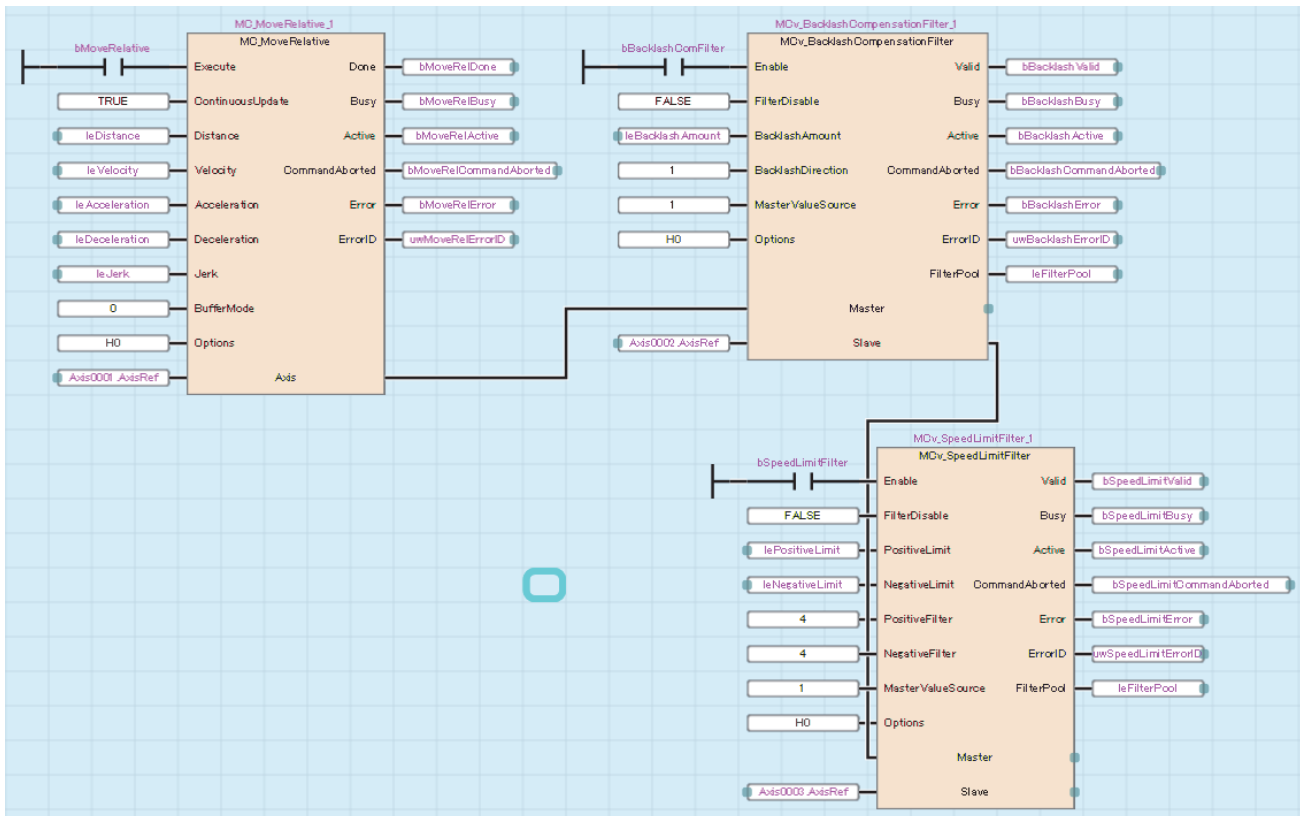
- Backlash amount



- Positive direction/negative direction limit value



- Relative Value Positioning/Backlash Compensation Filter/Speed Limit Filter



## ■ST program

//-----Data settings for single axis positioning-----

```
leDistance:= 100.0;
leVelocity:= 20.0;
leAcceleration:= 300.0;
leDeceleration:= 400.0;
leJerk:= 0.0;
```

//-----Relative Value Positioning-----

```
MC_MoveRelative_1(
  Axis:= VirtualAxis0001.AxisRef ,
  Execute:= bMoveRelative ,
  ContinuousUpdate:= TRUE ,
  Distance:= leDistance ,
  Velocity:= leVelocity ,
  Acceleration:= leAcceleration ,
  Deceleration:= leDeceleration ,
  Jerk:= leJerk ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= H00000000 ,
  Done=> bMoveRelDone ,
  Busy=> bMoveRelBusy ,
  Active=> bMoveRelActive ,
  CommandAborted=> bMoveRelCommandAborted ,
  Error=> bMoveRelError ,
  ErrorID=> uwMoveRelErrorID
);
```

//-----Backlash amount-----

```
leBacklashAmount:= 1.0;
```

//-----Backlash Compensation Filter-----

```
MCv_BacklashCompensationFilter_1(
  Master:= MC_MoveRelative_1.Axis ,
  Slave:= VirtualAxis0002.AxisRef ,
  Enable:= bBacklashComFilter ,
  FilterDisable:= FALSE ,
  BacklashAmount:= leBacklashAmount ,
  BacklashDirection:= MC_DIRECTION__mcPositiveDirection ,
  MasterValueSource:= MC_SOURCE__mcSetValue ,
  Options:= H00000000 ,
  Valid=> bBacklashValid ,
  Busy=> bBacklashBusy ,
  Active=> bBacklashActive ,
  CommandAborted=> bBacklashCommandAborted ,
  Error=> bBacklashError ,
  ErrorID=> uwBacklashErrorID ,
  FilterPool=> leBacklashFilterPool
);
```

//-----Positive direction/negative direction limit value-----

```
lePositiveLimit:= 100.0;
```

```

leNegativeLimit:= 100.0;

//-----Speed Limit Filter-----
MCv_SpeedLimitFilter_1(
    Master:= MCv_BacklashCompensationFilter_1.Slave ,
    Slave:= Axis0003.AxisRef ,
    Enable:= bSpeedLimitFilter ,
    FilterDisable:= FALSE ,
    PositiveLimit:= lePositiveLimit ,
    NegativeLimit:= leNegativeLimit ,
    PositiveFilter:= MC_VELOCITY_LIMIT_MODE__ClampWithoutRamp ,
    NegativeFilter:= MC_VELOCITY_LIMIT_MODE__ClampWithoutRamp ,
    MasterValueSource:= MC_SOURCE__mcSetValue ,
    Options:= H00000000 ,
    Valid=> bSpeedLimitValid ,
    Busy=> bSpeedLimitBusy ,
    Active=> bSpeedLimitActive ,
    CommandAborted=> bSpeedLimitCommandAborted ,
    Error=> bSpeedLimitError ,
    ErrorID=> uwSpeedLimitErrorID ,
    FilterPool=> leFilterPool
);

```

# 46.18 Smoothing Filter

46

## MCv\_SmoothingFilter

This FB performs filter processing according to the specified frequency.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MCv_SmoothingFilter(   Master:= ?AXIS_REF? ,   Slave:= ?AXIS_REF? ,   Enable:= ?BOOL? ,   FilterDisable:= ?BOOL? ,   Frequency:= ?LREAL? ,   FilterPurge:= ?BOOL? ,   MasterValueSource:= ?INT? ,   Options:= ?DWORD? ,   Valid=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   ValidFrequency=&gt; ?LREAL? ,   FilterPool=&gt; ?LREAL? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name        | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|-------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Master       | Master axis | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |
| Slave        | Slave axis  | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

## Input variable

| Input variable    | Name                              | Data type       | Input    | Valid range         | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------|-----------------------------------|-----------------|----------|---------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable            | Enable                            | BOOL            | Always   | TRUE, FALSE         | FALSE         | When this variable is set to TRUE, MCv_SmoothingFilter (Smoothing Filter) is executed.                                                                                                                                                                                                                                                                                                                                                                                         |
| FilterDisable     | Filter disable                    | BOOL            | Always   | TRUE, FALSE         | FALSE         | The filter processing method is set.<br><ul style="list-style-type: none"> <li>FALSE: Operates according to the filter setting.</li> <li>TRUE: Disables the filter and transmits the Master axis (Master) input to Slave axis (Slave) as it is.</li> </ul> For details, refer to the following.<br> Page 1864 Filter disable (FilterDisable)                                                |
| Frequency         | Frequency                         | LREAL           | Always   | 0.20 to 250.00 [Hz] | 10.00         | The frequency to suppress vibration is set.<br>For details, refer to the following.<br> Page 1864 Frequency (Frequency)                                                                                                                                                                                                                                                                     |
| FilterPurge       | Filter purge                      | BOOL            | At start | TRUE, FALSE         | FALSE         | The end operation with the filter cumulative value is set.<br><ul style="list-style-type: none"> <li>FALSE: The slave axis stops immediately.</li> <li>TRUE: The axis operates until the filter cumulative value becomes "0" and then stops.</li> </ul> For details, refer to the following.<br> Page 1865 Filter purge (FilterPurge)                                                       |
| MasterValueSource | Master axis data source selection | INT (MC_SOURCE) | At start | 1, 2, 101, 102      | 1             | The data source of Master axis (Master) is set.<br><ul style="list-style-type: none"> <li>1: Set value (mcSetValue)</li> <li>2: Actual value (mcActualValue)</li> <li>101: Latest set value (mcLatestSetValue)</li> <li>102: Latest actual value (mcLatestActualValue)</li> </ul> For details, refer to the following.<br> Page 1866 Master axis data source selection (MasterValueSource) |
| Options           | Options                           | DWORD(HEX)      | At start | 00000000H           | 00000000H     | Set "00000000H".<br>* If a value other than "00000000H" is set, Out of Options Range (error code: 1ABBH) occurs.                                                                                                                                                                                                                                                                                                                                                               |

## Output variables

| Output variable | Name                   | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------|------------------------|------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Valid           | Output value valid     | BOOL       | FALSE         | This variable becomes TRUE when the output value is valid.                                                                                                                                                                                                                                                                                                                                                     |
| Busy            | Executing              | BOOL       | FALSE         | This variable becomes TRUE when MCv_SmoothingFilter (Smoothing Filter) is executed.                                                                                                                                                                                                                                                                                                                            |
| Active          | Controlling            | BOOL       | FALSE         | This variable becomes TRUE when MCv_SmoothingFilter (Smoothing Filter) is controlling the axis.                                                                                                                                                                                                                                                                                                                |
| CommandAborted  | Abortion of execution  | BOOL       | FALSE         | This variable becomes TRUE when execution of MCv_SmoothingFilter (Smoothing Filter) is aborted.                                                                                                                                                                                                                                                                                                                |
| Error           | Error                  | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                                                                               |
| ErrorID         | Error code             | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                                                                                                                                                |
| ValidFrequency  | Valid frequency        | LREAL      | 0.00          | This variable outputs the valid frequency.                                                                                                                                                                                                                                                                                                                                                                     |
| FilterPool      | Filter cumulated value | LREAL      | 0.0           | This variable outputs the slave axis movement amount cumulated in filter processing.<br>The held value is cleared when Enable (Enable) is set to TRUE.<br>If the value of Filter cumulated value (FilterPool) exceeds the positioning range, Filter Cumulated Value Over Warning (event code: 00D13H) occurs.<br>When this warning is detected, the error of Filter cumulated value (FilterPool) may increase. |

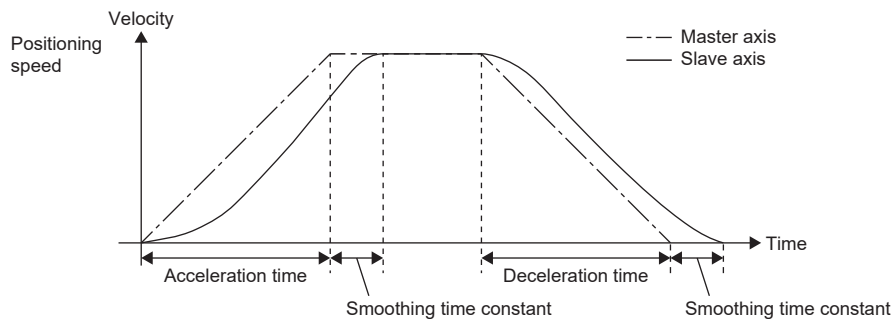


## Public variables

| Public variable  | Name                            | Data type | Default value | Description                                                                                                                                                                                                                                                     |
|------------------|---------------------------------|-----------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PurgedFilterPool | Disposed filter cumulated value | LREAL     | 0.0           | When Filter disable (FilterDisable) is set to TRUE, this variable stores the disposed value from Filter cumulated value (FilterPool).<br>Disposed filter cumulated value (PurgedFilterPool) is not cumulative.<br>The value is cleared to 0 at start of the FB. |

## Processing details

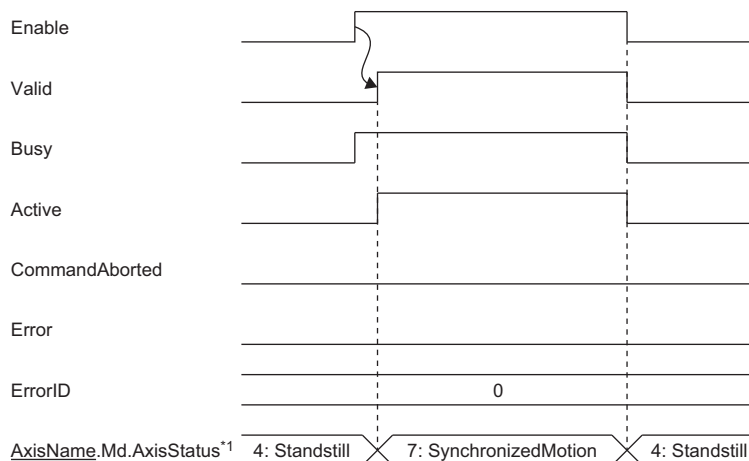
- This FB removes frequencies higher than the value set in Frequency (Frequency), and makes smooth acceleration/ deceleration waveforms.
- Smoothing filter outputs the result of filter processing executed for the Master axis (Master) value set in Master axis data source selection (MasterValueSource) to Slave axis (Slave).
- Axis status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "7: During synchronous operation (SynchronizedMotion)" during smoothing filter execution.
- The time constant of smoothing is " $1/\text{Frequency (Frequency)}[\text{s}]$ ", and the acceleration time and deceleration time become longer by the amount of the smoothing time constant. When Frequency (Frequency) is 10[Hz], the smoothing time constant is " $0.1[\text{s}] = 100[\text{ms}]$ ".



- If a smoothing filter is started while Slave axis (Slave) is in another operation FB, the start request will be ignored, and Start Not Possible (error code: 1AFCH) occurs. Start the smoothing filter when Axis status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "4: Standby (Standstill)".
- MC\_Stop (Forced Stop) is the only function block that can be multiple started during smoothing filter execution.

## Timing chart

- When the processing is completed successfully



\*1 Axis status of Slave axis (Slave)

- When the processing is completed with an error

For the timing chart, refer to the following.

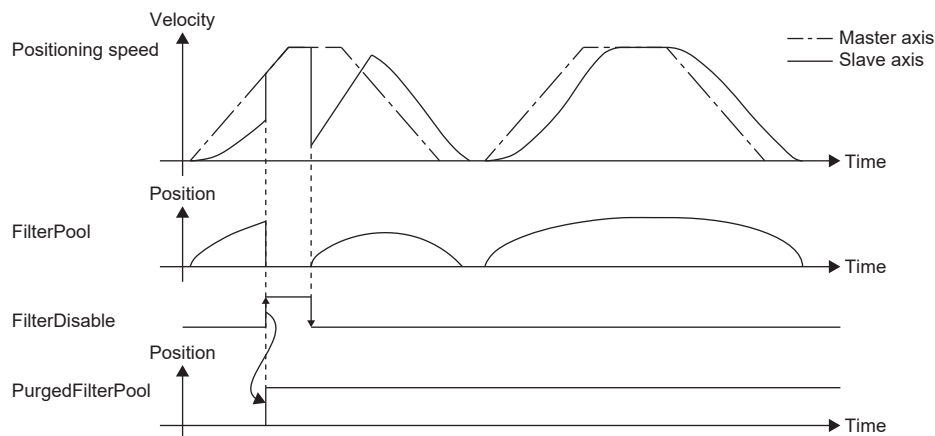
Page 1435 Basic operation of Enable (Enable) type motion control FBs

## ■Filter disable (FilterDisable)

Sets the method used for the filter processing.

| Setting value | Description                                                                                      |
|---------------|--------------------------------------------------------------------------------------------------|
| FALSE         | Operates according to the filter setting.                                                        |
| TRUE          | Disables the filter and transmits the Master axis (Master) input to Slave axis (Slave) as it is. |

- When Filter disable (FilterDisable) is set to TRUE, the value in Filter cumulated value (FilterPool) becomes "0.0" and the disposed value from Filter cumulated value (FilterPool) is stored in Disposed filter cumulated value (PurgedFilterPool).



## ■Frequency (Frequency)

Sets the frequency to suppress vibration.

The following shows the settable range for Frequency (Frequency).

| 1/Slave axis operation cycle[s] | Setting range                                  |
|---------------------------------|------------------------------------------------|
| 250.00 [Hz] or more             | 0.20 to 250.00 [Hz]                            |
| Less than 250.00 [Hz]           | 0.20 to (1/Slave axis operation cycle[s]) [Hz] |

- If a value outside the range is set in Frequency (Frequency), Out of Frequency Specification Range (error code: 1AE6H) occurs.
- Valid frequencies can be checked in Valid frequency (ValidFrequency).
- To change the frequency, change Frequency (Frequency) when Filter cumulated value (FilterPool) is "0.0". Even if it is changed in a status other than "0.0", the change will not be reflected until Filter cumulated value (FilterPool) becomes "0.0".
- Frequency (Frequency) cannot be changed to a frequency lower than Valid frequency (ValidFrequency). If a lower frequency is set, Out of Frequency Specification Range (error code: 1AE6H) occurs.
- Filter cumulated value (FilterPool) may become "0.0" while the master axis operates with the operation pattern which repeats positive/reverse rotation. When the value of Frequency (Frequency) is changed while the filter operation is not settled, the filter operation will be stopped in the middle. Thus, it causes the deviation between the master axis and the slave axis. To change Frequency (Frequency), check the master axis stop and wait for the filter time constant before changing.

■Filter purge (FilterPurge)

Sets the operation for when Enable (Enable) is set to FALSE and Filter cumulated value (FilterPool) is other than "0.0".

| Setting value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TRUE          | <p>When Enable (Enable) becomes FALSE, the axis operates until Filter cumulated value (FilterPool) reaches "0.0" and then stops.</p> <p>The diagram for FilterPurge = TRUE shows the following behavior: When Enable transitions from TRUE to FALSE, the slave axis continues to operate until the FilterPool value reaches 0.0. The Master axis velocity profile is a trapezoid. The Slave axis velocity profile follows the Master axis velocity with a smoothing time constant. The FilterPool value starts at 0.0, increases during the acceleration phase, remains constant during the constant velocity phase, and then decreases back to 0.0 during the deceleration phase. The time taken for FilterPool to reach 0.0 after Enable becomes FALSE is indicated by a double-headed arrow labeled 'Smoothing time constant'.</p> |
| FALSE         | <p>When Enable (Enable) becomes FALSE, immediately stops the slave axis regardless of the Filter cumulated value (FilterPool) status.</p> <p>The diagram for FilterPurge = FALSE shows the following behavior: When Enable transitions from TRUE to FALSE, the slave axis stops immediately, regardless of the FilterPool value. The Master axis velocity profile is a trapezoid. The Slave axis velocity profile follows the Master axis velocity with a smoothing time constant. The FilterPool value starts at 0.0, increases during the acceleration phase, and remains constant during the constant velocity phase. When Enable becomes FALSE, the slave axis stops immediately, and the FilterPool value remains constant.</p>                                                                                                  |

## ■ Master axis data source selection (MasterValueSource)

Slave axis (Slave) sets the position type of Master axis (Master) that will execute single axis synchronous control.

The operation may differ depending on the execution order of the FBs or if the operation cycles of Master axis (Master) and Slave axis (Slave) are different.

Operates with the same value as the set value when specifying Actual value in Master axis data source selection (MasterValueSource) while an axis type other than real axis is set in Master axis (Master).

| Setting value                                  | Description                                                                     |
|------------------------------------------------|---------------------------------------------------------------------------------|
| 1: Set value (mcSetValue)                      | Uses the commanded position of the master axis in the previous operation cycle. |
| 2: Actual value (mcActualValue)                | Uses the actual position of the master axis in the previous operation cycle.    |
| 101: Latest set value (mcLatestSetValue)       | Uses the commanded position of the master axis in the current operation cycle.  |
| 102: Latest actual value (mcLatestActualValue) | Uses the actual position of the master axis in the current operation cycle.     |

### Point

When Master axis data source selection (MasterValueSource) is set to "1: Set value (mcSetValue)" or "101: Latest set value (mcLatestSetValue)" and the master axis becomes servo OFF by a servo alarm or forced stop, the amount of the value change may be too large. This can be prevented by setting Master axis data source selection (MasterValueSource) to "2: Actual value (mcActualValue)" or "102: Latest actual value (mcLatestActualValue)".

## Precautions

- For the smoothing filter, the operation load increases as the filter level increases. A rough standard for the operation load when the filter level is 5000 is approximately 415 [ $\mu$ s].
- The filter level is calculated with the following formula. Digits after the decimal point are rounded/up down to the nearest integer. When the result of rounding is "0", the operation is carried out as 1 level.  
Filter level = (1 / frequency[Hz]) / operation cycle[s]
- The smoothing filter secures the memory to use for filter processing at start. The memory usage can be calculated with the following formula. If memory is insufficient, change Maximum RAM size (AddonSystem.PrConst.MT\_MotionControl\_AxisFilter.RamSizeMax) of Addon MotionControl\_AxisFilter parameter (Addon\_MotionControl\_AxisFilter).  
Memory usage = Filter level  $\times$  8 [Bytes]
- The operation error may increase when the movement amount of the master axis or the slave axis is large and the following case applies. Confirm the unit setting of the master axis and the slave axis and decrease the movement range. If the error increases, clear the synchronization status or execute the current value change of absolute position specification.
- When the total sum of the movement amount (the following formula) equivalent to filter level at control exceeds the number of significant digits which can be represented by double-precision floating-point (approximately 15 digits).

Filter level - 1

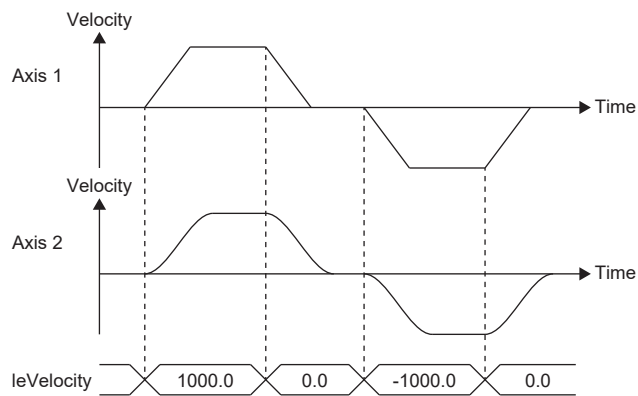
$$\sum_{i=0} (i \text{ Position of the master axis before the operation cycle} - \text{Position of the master axis at the start of control})$$

- If Filter disable (FilterDisable) is switched during operation, the Slave axis (Slave) velocity may change rapidly.
- After enabling the command filter, when the Master axis (Master) command is not transmitted to Slave axis (Slave) or the back part synchronous control FB because the stop factor occurred on Slave axis (Slave), the synchronous position relation deviates. Before enabling the command filter again, execute the synchronous positioning as needed.

## Program example

The following is a program example. The filter processing that changes the trapezoidal acceleration/deceleration to a smooth acceleration/deceleration waveform is performed.

### • Operation



### • Settings

| Item                            |              | Setting value |
|---------------------------------|--------------|---------------|
| Frequency                       |              | 10.00         |
| Data settings for speed control | Velocity     | 5000.0        |
|                                 | Acceleration | 100.0         |
|                                 | Deceleration | 100.0         |
|                                 | Jerk         | 0.0           |

### ■ Axes

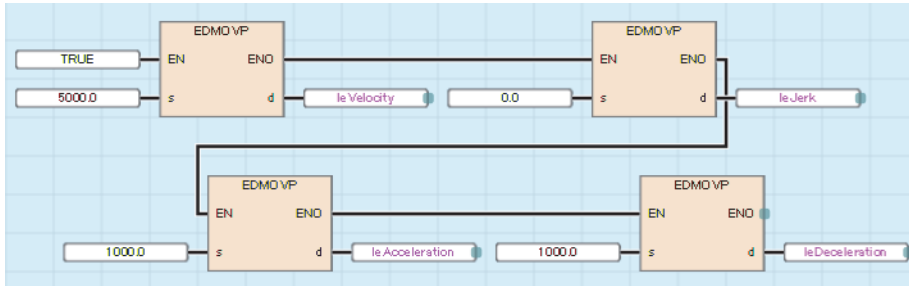
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |
| 2        | Axis0002   | AXIS_REF  | Axis 2  |

## ■Labels used

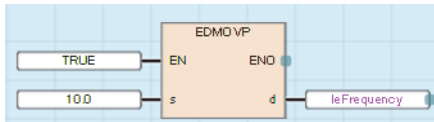
| Label name                | Data type                           | Comment                                    |
|---------------------------|-------------------------------------|--------------------------------------------|
| MCv_SpeedControl_1        | MCv_SpeedControl                    | Speed Control (Including Position Loop) FB |
| bSpeedControl             | Bit                                 | Speed control command                      |
| leVelocity                | Double-precision real number        | Command velocity                           |
| leAcceleration            | Double-precision real number        | Acceleration                               |
| leDeceleration            | Double-precision real number        | Deceleration                               |
| leJerk                    | Double-precision real number        | Jerk                                       |
| bSpeedInVelocity          | Bit                                 | Target velocity reached                    |
| bSpeedBusy                | Bit                                 | Executing                                  |
| bSpeedActive              | Bit                                 | Controlling                                |
| bSpeedCommandAborted      | Bit                                 | Abortion of execution                      |
| bSpeedError               | Bit                                 | Error                                      |
| uwSpeedErrorID            | Word [unsigned]/bit string [16-bit] | Error code                                 |
| MCv_SmoothingFilter_1     | MCv_SmoothingFilter                 | Smoothing Filter FB                        |
| bSmoothingFilter          | Bit                                 | Smoothing filter command                   |
| leFrequency               | Double-precision real number        | Frequency                                  |
| bSmoothingValid           | Bit                                 | Output value valid                         |
| bSmoothingInVelocity      | Bit                                 | Target velocity reached                    |
| bSmoothingBusy            | Bit                                 | Executing                                  |
| bSmoothingActive          | Bit                                 | Controlling                                |
| bSmoothingCommandAborted  | Bit                                 | Abortion of execution                      |
| bSmoothingError           | Bit                                 | Error                                      |
| uwSmoothingErrorID        | Word [unsigned]/bit string [16-bit] | Error code                                 |
| leSmoothingValidFrequency | Double-precision real number        | Valid frequency                            |
| leSmoothingFilterPool     | Double-precision real number        | Filter cumulated value                     |

## ■ FBD/LD program

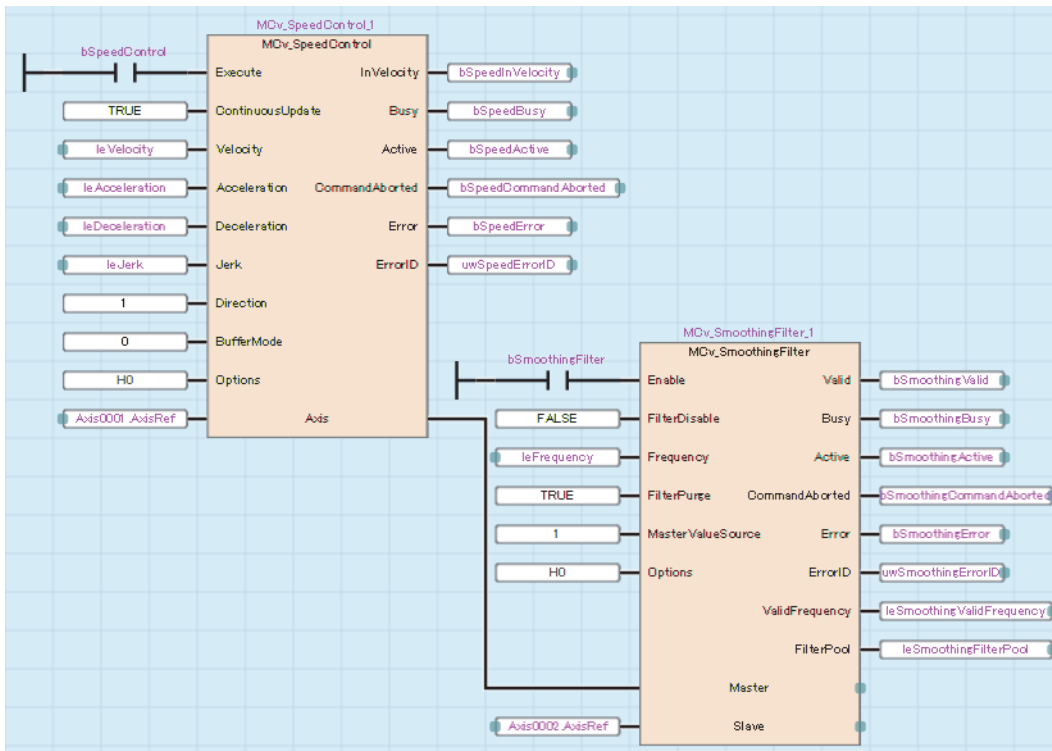
- Data settings for speed control



- Frequency



- Speed Control/Smoothing Filter



## ■ST program

//-----Data settings for speed control-----

```
leVelocity:= 5000.0;  
leAcceleration:= 1000.0;  
leDeceleration:= 1000.0;  
leJerk:= 0.0;
```

//-----Speed Control-----

```
MCv_SpeedControl_1(  
  Axis:= Axis0001.AxisRef ,  
  Execute:= bSpeedControl ,  
  ContinuousUpdate:= TRUE ,  
  Velocity:= leVelocity ,  
  Acceleration:= leAcceleration ,  
  Deceleration:= leDeceleration ,  
  Jerk:= leJerk ,  
  Direction:= MC_DIRECTION__mcPositiveDirection ,  
  BufferMode:= MC_BUFFER_MODE__mcAborting ,  
  Options:= H00000000 ,  
  InVelocity=> bSpeedInVelocity ,  
  Busy=> bSpeedBusy ,  
  Active=> bSpeedActive ,  
  CommandAborted=> bSpeedCommandAborted ,  
  Error=> bSpeedError ,  
  ErrorID=> uwSpeedErrorID  
);
```

//-----Frequency-----

```
leFrequency:= 10.00;
```

//-----Smoothing Filter-----

```
MCv_SmoothingFilter_1(  
  Master:= MCv_SpeedControl_1.Axis ,  
  Slave:= Axis0002.AxisRef ,  
  Enable:= bSmoothingFilter ,  
  FilterDisable:= FALSE ,  
  Frequency:= leFrequency ,  
  FilterPurge:= TRUE ,  
  MasterValueSource:= MC_SOURCE__mcSetValue ,  
  Options:= H00000000 ,  
  Valid=> bSmoothingValid ,  
  Busy=> bSmoothingBusy ,  
  Active=> bSmoothingActive ,  
  CommandAborted=> bSmoothingCommandAborted ,  
  Error=> bSmoothingError ,  
  ErrorID=> uwSmoothingErrorID ,  
  ValidFrequency=> leSmoothingValidFrequency ,  
  FilterPool=> leSmoothingFilterPool  
);
```



# 46.19 Moving Direction Restriction Filter

46

## MCv\_DirectionFilter

This FB performs filter processing to restrict traveling for the set movement direction.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MCv_DirectionFilter(   Master:= ?AXIS_REF? ,   Slave:= ?AXIS_REF? ,   Enable:= ?BOOL? ,   FilterDisable:= ?BOOL? ,   PositiveDisable:= ?BOOL? ,   NegativeDisable:= ?BOOL? ,   Filter:= ?INT? ,   MasterValueSource:= ?INT? ,   Options:= ?DWORD? ,   Valid=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   FilterPool=&gt; ?LREAL? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name        | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|-------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Master       | Master axis | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |
| Slave        | Slave axis  | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable  | Name                     | Data type | Input    | Valid range | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------|--------------------------|-----------|----------|-------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable          | Enable                   | BOOL      | Always   | TRUE, FALSE | FALSE         | When this variable is set to TRUE, MCv_DirectionFilter (Moving Direction Restriction Filter) is executed.                                                                                                                                                                                                                                                                                                                                     |
| FilterDisable   | Filter disable           | BOOL      | Always   | TRUE, FALSE | FALSE         | The filter processing method is set.<br>• FALSE: Operates according to the filter setting.<br>• TRUE: Disables the filter and transmits the Master axis (Master) input to Slave axis (Slave) as it is.<br>For details, refer to the following.<br>Page 1874 Filter disable (FilterDisable)                                                                                                                                                    |
| PositiveDisable | Positive direction limit | BOOL      | At start | TRUE, FALSE | FALSE         | When this variable is set to TRUE, the axis operation to the positive direction is limited.<br>Slave axis (Slave) does not operate at Master axis (Master) forward rotation operation.<br>When both Positive direction limit (PositiveDisable) and Negative direction limit (NegativeDisable) are set to TRUE, Slave axis (Slave) will not operate even if Master axis (Master) is operated.<br>• FALSE: Not restricted<br>• TRUE: Restricted |

| Input variable    | Name                              | Data type                       | Input    | Valid range    | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------|-----------------------------------|---------------------------------|----------|----------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NegativeDisable   | Negative direction limit          | BOOL                            | At start | TRUE, FALSE    | FALSE         | When this variable is set to TRUE, the axis operation to the negative direction is limited.<br>Slave axis (Slave) does not operate at Master axis (Master) reverse rotation operation.<br>When both Positive direction limit (PositiveDisable) and Negative direction limit (NegativeDisable) are set to TRUE, Slave axis (Slave) will not operate even if Master axis (Master) is operated.<br>• FALSE: Not restricted<br>• TRUE: Restricted |
| Filter            | Filter operation                  | INT<br>(MC_VELOCITY_LIMIT_MODE) | At start | 0, 2, 4        | 2             | The filter operation is set.<br>• 0: Ignore (Ignore)<br>• 2: Truncate (Truncate)<br>• 4: Clamp (Without Ramp at Deceleration) (ClampWithoutRamp)<br>For details, refer to the following.<br> Page 1875 Filter operation (Filter)                                                                                                                           |
| MasterValueSource | Master axis data source selection | INT<br>(MC_SOURCE)              | At start | 1, 2, 101, 102 | 1             | The data source of Master axis (Master) is set.<br>• 1: Set value (mcSetValue)<br>• 2: Actual value (mcActualValue)<br>• 101: Latest set value (mcLatestSetValue)<br>• 102: Latest actual value (mcLatestActualValue)<br>For details, refer to the following.<br> Page 1876 Master axis data source selection (MasterValueSource)                          |
| Options           | Options                           | DWORD(HEX)                      | At start | 0000000H       | 0000000H      | Set "00000000H".<br>* If a value other than "00000000H" is set, Out of Options Range (error code: 1ABBH) occurs.                                                                                                                                                                                                                                                                                                                              |

## ■Output variables

| Output variable | Name                   | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------|------------------------|------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Valid           | Output value valid     | BOOL       | FALSE         | This variable becomes TRUE when the output value is valid.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Busy            | Executing              | BOOL       | FALSE         | This variable becomes TRUE when MCv_DirectionFilter (Moving Direction Restriction Filter) is executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Active          | Controlling            | BOOL       | FALSE         | This variable becomes TRUE when MCv_DirectionFilter (Moving Direction Restriction Filter) is controlling the axis.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| CommandAborted  | Abortion of execution  | BOOL       | FALSE         | This variable becomes TRUE when execution of MCv_DirectionFilter (Moving Direction Restriction Filter) is aborted.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Error           | Error                  | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| ErrorID         | Error code             | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                                                                                                                                                                                                                                                                                                     |
| FilterPool      | Filter cumulated value | LREAL      | 0.0           | This variable outputs the slave axis movement amount cumulated in filter processing.<br>When Enable (Enable) is set to FALSE while a value of this variable is other than "0.0", the value when Enable (Enable) was set to FALSE is held.<br>The held value is cleared when Enable (Enable) is set to TRUE.<br>If the value of Filter cumulated value (FilterPool) exceeds the positioning range, Filter Cumulated Value Over Warning (event code: 00D13H) occurs.<br>When this warning is detected, the error of Filter cumulated value (FilterPool) may increase. |

## ■Public variables

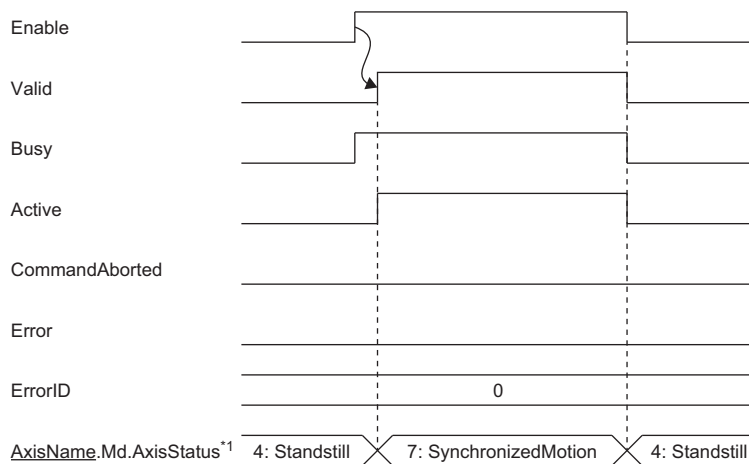
| Public variable  | Name                            | Data type | Default value | Description                                                                                                                                                                                                                                                     |
|------------------|---------------------------------|-----------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PurgedFilterPool | Disposed filter cumulated value | LREAL     | 0.0           | When Filter disable (FilterDisable) is set to TRUE, this variable stores the disposed value from Filter cumulated value (FilterPool).<br>Disposed filter cumulated value (PurgedFilterPool) is not cumulative.<br>The value is cleared to 0 at start of the FB. |

## Processing details

- This FB restricts the movement of the slave axis to one direction in relation to the master axis movement.
- Moving direction limit filter takes the result of filter processing executed for the Master axis (Master) value set in Master axis data source selection (MasterValueSource) and outputs it to Slave axis (Slave).
- Axis status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "7: During synchronous operation (SynchronizedMotion)" during moving direction filter execution.
- If a moving direction limit filter is started while Slave axis (Slave) is in another operation FB, the start request will be ignored, and Start Not Possible (error code: 1AFCH) occurs. Start the moving direction limit filter when Axis status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "4: Standby (Standstill)".
- MC\_Stop (Forced Stop) is the only function block that can be multiple started during smoothing filter execution.
- When setting Enable (Enable) to FALSE, perform this function block while the slave axis is in stop status. If Enable (Enable) is set to FALSE while the slave axis is in operation, the slave axis will stop immediately.

### ■ Timing chart

- When the processing is completed successfully



\*1 Axis status of Slave axis (Slave)

- When the processing is completed with an error

For the timing chart, refer to the following.

📖 Page 1435 Basic operation of Enable (Enable) type motion control FBs

■Filter disable (FilterDisable)

Sets the method used for the filter processing.

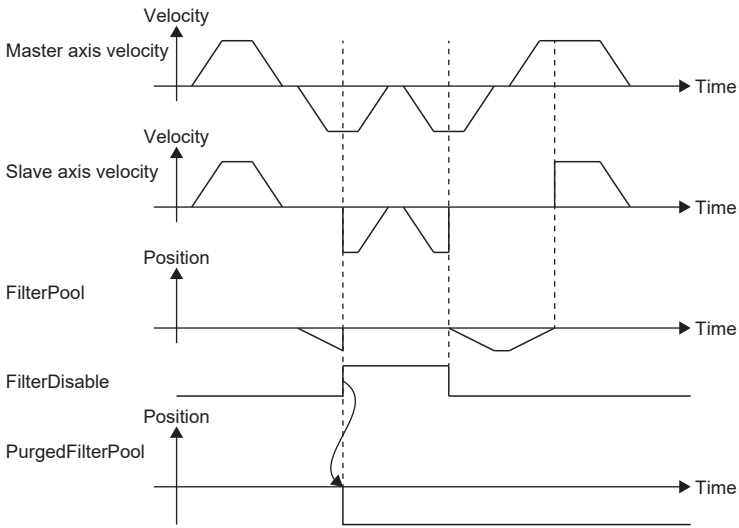
| Setting value | Description                                                                                      |
|---------------|--------------------------------------------------------------------------------------------------|
| FALSE         | Operates according to the filter setting.                                                        |
| TRUE          | Disables the filter and transmits the Master axis (Master) input to Slave axis (Slave) as it is. |

- When Filter disable (FilterDisable) is set to TRUE, the value in Filter cumulated value (FilterPool) becomes "0.0" and the disposed value from Filter cumulated value (FilterPool) is stored in Disposed filter cumulated value (PurgedFilterPool).

Ex.

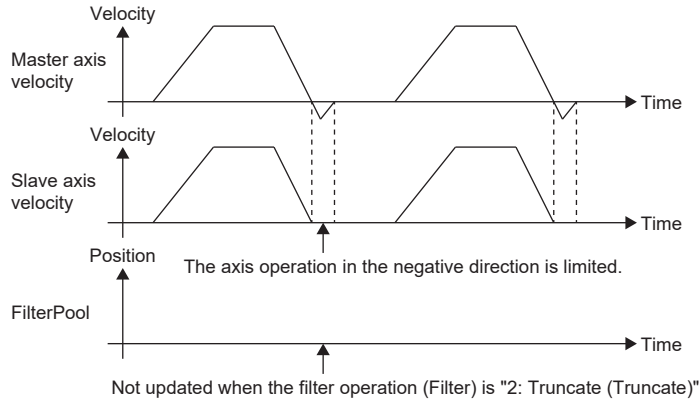
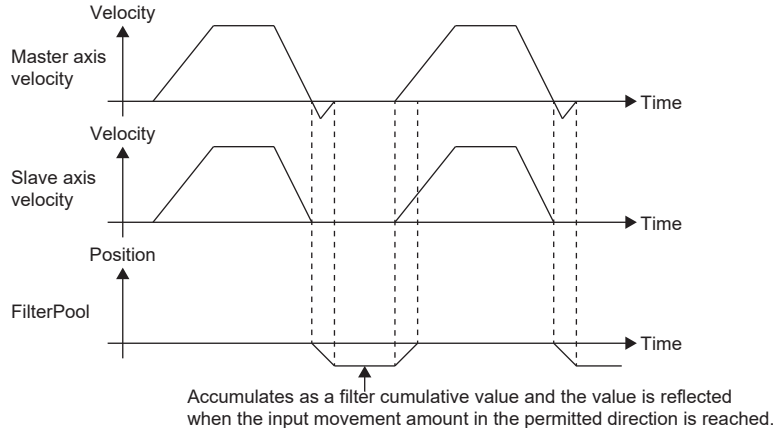
When set as shown below

| Input pin                                  | Setting value                                              |
|--------------------------------------------|------------------------------------------------------------|
| Filter operation (Filter)                  | 4: Clamp (Without Ramp at Deceleration) (ClampWithoutRamp) |
| Positive direction limit (PositiveDisable) | FALSE (Not limited)                                        |
| Negative direction limit (NegativeDisable) | TRUE (Limited)                                             |



## ■Filter operation (Filter)

- Sets the slave axis operation at control based on the setting of Filter operation (Filter).

| Setting value                                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Ignore (Ignore)                                         | <ul style="list-style-type: none"> <li>The movement direction is not restricted.</li> <li>Filter cumulated value (FilterPool) is not updated.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 2: Truncate (Truncate)                                     | <ul style="list-style-type: none"> <li>The movement amount to the restricted direction is ignored and is not added to Filter cumulated value (FilterPool).</li> <li>The movement amount to the restricted direction will be truncated, and the position relation between the master axis and the slave axis will deviate by an amount equal to the movement amount to the restricted direction.</li> </ul> <p>&lt;Example&gt;<br/>When Positive direction limit (PositiveDisable) is FALSE, and Negative direction limit (NegativeDisable) is TRUE</p>  <p>The axis operation in the negative direction is limited.</p> <p>Not updated when the filter operation (Filter) is "2: Truncate (Truncate)"</p>                                                                                      |
| 4: Clamp (Without Ramp at Deceleration) (ClampWithoutRamp) | <ul style="list-style-type: none"> <li>The movement amount to the restricted direction is added to Filter cumulated value (FilterPool).</li> <li>Filter cumulated value (FilterPool) reflects the reverse direction movement. Thus, even if operation to the restricted direction is repeated, the position relation between the master axis and the slave axis will not deviate from that when the status of Filter cumulated value (FilterPool) is "0.0".</li> </ul> <p>&lt;Example&gt;<br/>When Positive direction limit (PositiveDisable) is FALSE (Not limited), and Negative direction limit (NegativeDisable) is TRUE (Limited)</p>  <p>Accumulates as a filter cumulative value and the value is reflected when the input movement amount in the permitted direction is reached.</p> |

- If a value outside the range is set in Filter operation (Filter), Out of Filter Operation Specification Range (error code: 1AE7H) occurs.

## ■ Master axis data source selection (MasterValueSource)

Slave axis (Slave) sets the position type of Master axis (Master) that will execute single axis synchronous control.

The operation may differ depending on the execution order of the FBs or if the operation cycles of Master axis (Master) and Slave axis (Slave) are different.

Operates with the same value as the set value when specifying Actual value in Master axis data source selection (MasterValueSource) while an axis type other than real axis is set in Master axis (Master).

| Setting value                                  | Description                                                                     |
|------------------------------------------------|---------------------------------------------------------------------------------|
| 1: Set value (mcSetValue)                      | Uses the commanded position of the master axis in the previous operation cycle. |
| 2: Actual value (mcActualValue)                | Uses the actual position of the master axis in the previous operation cycle.    |
| 101: Latest set value (mcLatestSetValue)       | Uses the commanded position of the master axis in the current operation cycle.  |
| 102: Latest actual value (mcLatestActualValue) | Uses the actual position of the master axis in the current operation cycle.     |

### Point

When Master axis data source selection (MasterValueSource) is set to "1: Set value (mcSetValue)" or "101: Latest set value (mcLatestSetValue)" and the master axis becomes servo OFF by a servo alarm or forced stop, the amount of the value change may be too large. This can be prevented by setting Master axis data source selection (MasterValueSource) to "2: Actual value (mcActualValue)" or "102: Latest actual value (mcLatestActualValue)".

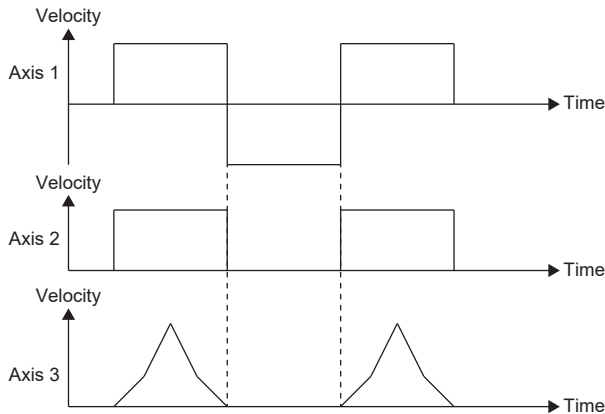
## Precautions

- If Filter disable (FilterDisable) is switched during operation, the Slave axis (Slave) velocity may change rapidly.
- After enabling the command filter, when the Master axis (Master) command is not transmitted to Slave axis (Slave) or the back part synchronous control FB because the stop factor occurred on Slave axis (Slave), the synchronous position relation deviates. Before enabling the command filter again, execute the synchronous positioning as needed.

## Program example

The following is a program example. The filter processing that restricts the direction of the cam operation is performed.

### • Operation



### • Settings

| Item           | Setting value |
|----------------|---------------|
| Cam ID setting | 1             |

### ■Axes

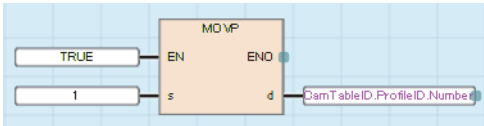
| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REF  | Axis 1  |
| 2        | Axis0002   | AXIS_REF  | Axis 2  |
| 3        | Axis0003   | AXIS_REF  | Axis 3  |

### ■Labels used

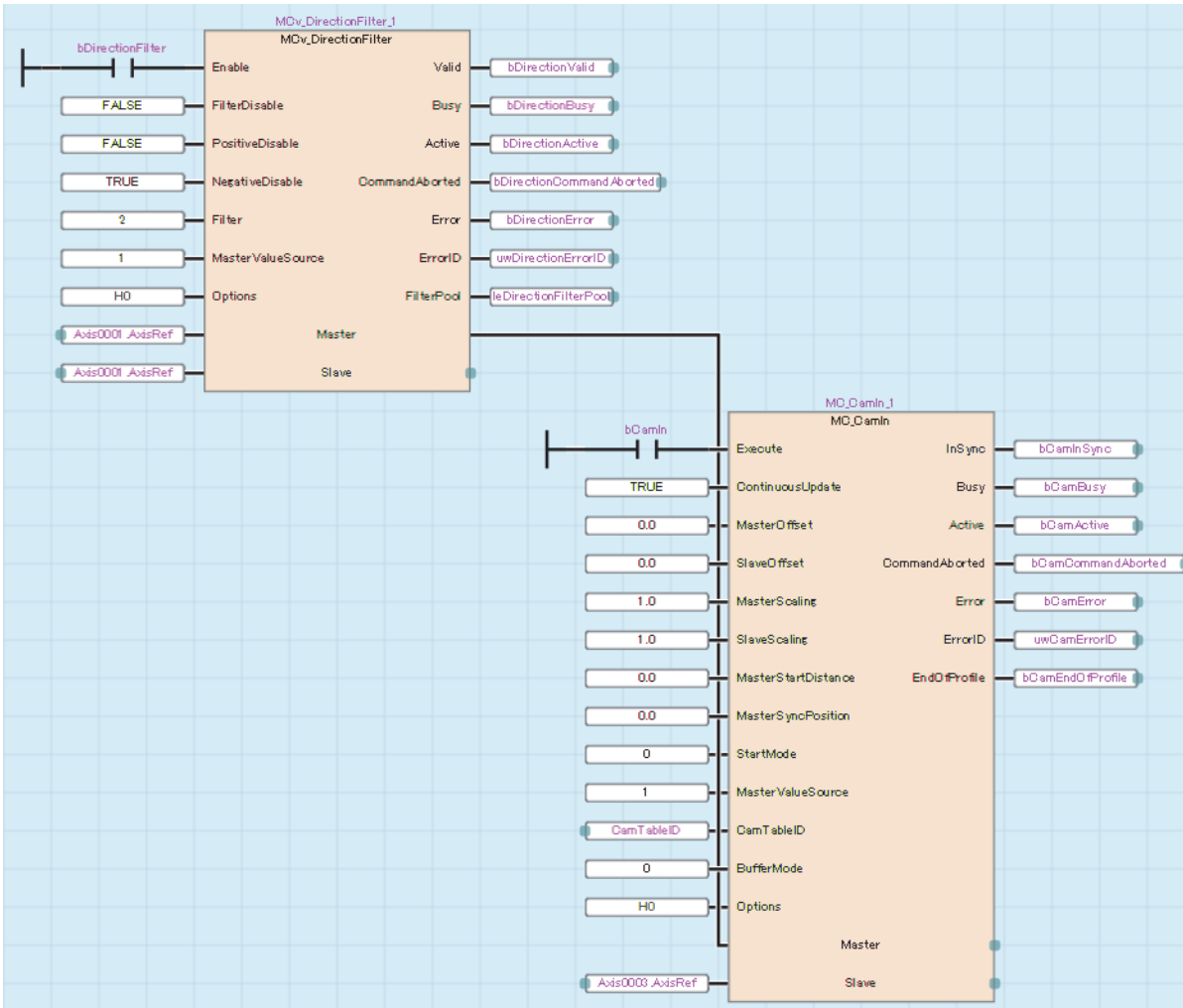
| Label name               | Data type                           | Comment                                     |
|--------------------------|-------------------------------------|---------------------------------------------|
| MCv_DirectionFilter_1    | MCv_DirectionFilter                 | Moving Direction Restriction Filter FB      |
| bDirectionFilter         | Bit                                 | Moving direction restriction filter command |
| bDirectionValid          | Bit                                 | Output value valid                          |
| bDirectionBusy           | Bit                                 | Executing                                   |
| bDirectionActive         | Bit                                 | Controlling                                 |
| bDirectionCommandAborted | Bit                                 | Abortion of execution                       |
| bDirectionError          | Bit                                 | Error                                       |
| uwDirectionErrorID       | Word [unsigned]/bit string [16-bit] | Error code                                  |
| leDirectionFilterPool    | Double-precision real number        | Disposed filter cumulated value             |
| MC_CamIn_1               | MC_CamIn                            | Cam Operation Start FB                      |
| bCamIn                   | Bit                                 | Cam operation command                       |
| CamTableID               | MC_CAM_ID                           | Cam ID                                      |
| bCamInSync               | Bit                                 | In synchronization                          |
| bCamBusy                 | Bit                                 | Executing                                   |
| bCamActive               | Bit                                 | Controlling                                 |
| bCamCommandAborted       | Bit                                 | Abortion of execution                       |
| bCamError                | Bit                                 | Error                                       |
| uwCamErrorID             | Word [unsigned]/bit string [16-bit] | Error code                                  |
| bCamEndOfProfile         | Bit                                 | Cam cycle completion                        |

## ■FBD/LD program

- Cam ID setting



- Moving Direction Restriction Filter/cam operation





## ■ST program

//----Moving Direction Restriction Filter----

```
MCv_DirectionFilter_1(
  Master:= Axis0001.AxisRef ,
  Slave:= Axis0002.AxisRef ,
  Enable:= bDirectionFilter ,
  FilterDisable:= FALSE ,
  PositiveDisable:= FALSE ,
  NegativeDisable:= TRUE ,
  Filter:= MC_VELOCITY_LIMIT_MODE__Truncate ,
  MasterValueSource:= MC_SOURCE__mcSetValue ,
  Options:= H00000000 ,
  Valid=> bDirectionValid ,
  Busy=> bDirectionBusy ,
  Active=> bDirectionActive ,
  CommandAborted=> bDirectionCommandAborted ,
  Error=> bDirectionError ,
  ErrorID=> uwDirectionErrorID ,
  FilterPool=> leDirectionFilterPool
);
```

//Cam ID settings

CamTableID.ProfileID.Number:= 1;

//Cam operation

```
MC_CamIn_1(
  Master:= MCv_DirectionFilter_1.Slave ,
  Slave:= Axis0003.AxisRef ,
  Execute:= bCamIn ,
  ContinuousUpdate:= TRUE ,
  MasterOffset:= 0.0 ,
  SlaveOffset:= 0.0 ,
  MasterScaling:= 1.0 ,
  SlaveScaling:= 1.0 ,
  MasterStartDistance:= 0.0 ,
  MasterSyncPosition:= 0.0 ,
  StartMode:= MC_START_MODE__mcImmediate ,
  MasterValueSource:= MC_SOURCE__mcSetValue ,
  CamTableID:= CamTableID ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= H00000000 ,
  InSync=> bCamInSync ,
  Busy=> bCamBusy ,
  Active=> bCamActive ,
  CommandAborted=> bCamCommandAborted ,
  Error=> bCamError ,
  ErrorID=> uwCamErrorID ,
  EndOfProfile=> bCamEndOfProfile
);
```

## 46.20 Speed Limit Filter

### MCv\_SpeedLimitFilter

This FB performs filter processing to restrict to the velocity of the set limit value.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MCv_SpeedLimitFilter(   Master:= ?AXIS_REF? ,   Slave:= ?AXIS_REF? ,   Enable:= ?BOOL? ,   FilterDisable:= ?BOOL? ,   PositiveLimit:= ?LREAL? ,   NegativeLimit:= ?LREAL? ,   PositiveFilter:= ?INT? ,   NegativeFilter:= ?INT? ,   MasterValueSource:= ?INT? ,   Options:= ?DWORD? ,   Valid=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   FilterPool=&gt; ?LREAL? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name        | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|-------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Master       | Master axis | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |
| Slave        | Slave axis  | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable | Name                           | Data type | Input    | Valid range                 | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------|--------------------------------|-----------|----------|-----------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable         | Enable                         | BOOL      | Always   | TRUE, FALSE                 | FALSE         | When this variable is set to TRUE, MCv_SpeedLimitFilter (Speed Limit Filter) is executed.                                                                                                                                                                                                                                                                                                                       |
| FilterDisable  | Filter disable                 | BOOL      | Always   | TRUE, FALSE                 | FALSE         | The filter processing method is set.<br>• FALSE: Operates according to the filter setting.<br>• TRUE: Disables the filter and transmits the Master axis (Master) input to Slave axis (Slave) as it is.<br>For details, refer to the following.<br>Page 1883 Filter disable (FilterDisable)                                                                                                                      |
| PositiveLimit  | Positive direction limit value | LREAL     | At start | 0.0, 0.0001 to 2500000000.0 | 0.0           | The speed limit value of the positive direction is set.<br>Sets the upper limit value of the velocity output to Slave axis (Slave) in relation to the Master axis (Master) positive direction input velocity.<br>When "0.0" is set, Slave axis does not operate to the positive direction.<br>If a value outside the range is set, Out of Direction Limit Value Specification Range (error code: 1AE8H) occurs. |

| Input variable    | Name                                | Data type                       | Input    | Valid range                 | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------|-------------------------------------|---------------------------------|----------|-----------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NegativeLimit     | Negative direction limit value      | LREAL                           | At start | 0.0, 0.0001 to 2500000000.0 | 0.0           | The speed limit value of the negative direction is set.<br>Sets the upper limit value of the velocity output to Slave axis (Slave) in relation to the Master axis (Master) negative direction input velocity.<br>When "0.0" is set, Slave axis does not operate to the negative direction.<br>If a value outside the range is set, Out of Direction Limit Value Specification Range (error code: 1AE8H) occurs.                                   |
| PositiveFilter    | Positive direction filter operation | INT<br>(MC_VELOCITY_LIMIT_MODE) | At start | 0, 2, 4                     | 2             | The filter operation when the positive direction limit is exceeded is set.<br>• 0: Ignore (Ignore)<br>• 2: Truncate (Truncate)<br>• 4: Clamp (Without Ramp at Deceleration) (ClampWithoutRamp)<br>For details, refer to the following.<br> Page 1884 Positive direction filter operation (PositiveFilter)/Negative direction filter operation (NegativeFilter) |
| NegativeFilter    | Negative direction filter operation | INT<br>(MC_VELOCITY_LIMIT_MODE) | At start | 0, 2, 4                     | 2             | The filter operation when the negative direction limit is exceeded is set.<br>• 0: Ignore (Ignore)<br>• 2: Truncate (Truncate)<br>• 4: Clamp (Without Ramp at Deceleration) (ClampWithoutRamp)<br>For details, refer to the following.<br> Page 1884 Positive direction filter operation (PositiveFilter)/Negative direction filter operation (NegativeFilter) |
| MasterValueSource | Master axis data source selection   | INT<br>(MC_SOURCE)              | At start | 1, 2, 101, 102              | 1             | The data source of Master axis (Master) is set.<br>• 1: Set value (mcSetValue)<br>• 2: Actual value (mcActualValue)<br>• 101: Latest set value (mcLatestSetValue)<br>• 102: Latest actual value (mcLatestActualValue)<br>For details, refer to the following.<br> Page 1885 Master axis data source selection (MasterValueSource)                            |
| Options           | Options                             | DWORD(HEX)                      | At start | 00000000H                   | 00000000H     | Set "00000000H".<br>* If a value other than "00000000H" is set, Out of Options Range (error code: 1ABBH) occurs.                                                                                                                                                                                                                                                                                                                                  |

## ■ Output variables

| Output variable | Name                   | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------|------------------------|------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Valid           | Output value valid     | BOOL       | FALSE         | This variable becomes TRUE when the output value is valid.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Busy            | Executing              | BOOL       | FALSE         | This variable becomes TRUE when MCv_SpeedLimitFilter (Speed Limit Filter) is executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Active          | Controlling            | BOOL       | FALSE         | This variable indicates that the FB is controlling the axis.<br>The variable becomes TRUE when MCv_SpeedLimitFilter (Speed Limit Filter) is controlling the axis.                                                                                                                                                                                                                                                                                                                                                                                                   |
| CommandAborted  | Abortion of execution  | BOOL       | FALSE         | This variable becomes TRUE when execution of MCv_SpeedLimitFilter (Speed Limit Filter) is aborted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Error           | Error                  | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| ErrorID         | Error code             | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                                                                                                                                                                                                                                                                                                     |
| FilterPool      | Filter cumulated value | LREAL      | 0.0           | This variable outputs the slave axis movement amount cumulated in filter processing.<br>When Enable (Enable) is set to FALSE while a value of this variable is other than "0.0", the value when Enable (Enable) was set to FALSE is held.<br>The held value is cleared when Enable (Enable) is set to TRUE.<br>If the value of Filter cumulated value (FilterPool) exceeds the positioning range, Filter Cumulated Value Over Warning (event code: 00D13H) occurs.<br>When this warning is detected, the error of Filter cumulated value (FilterPool) may increase. |

## ■Public variables

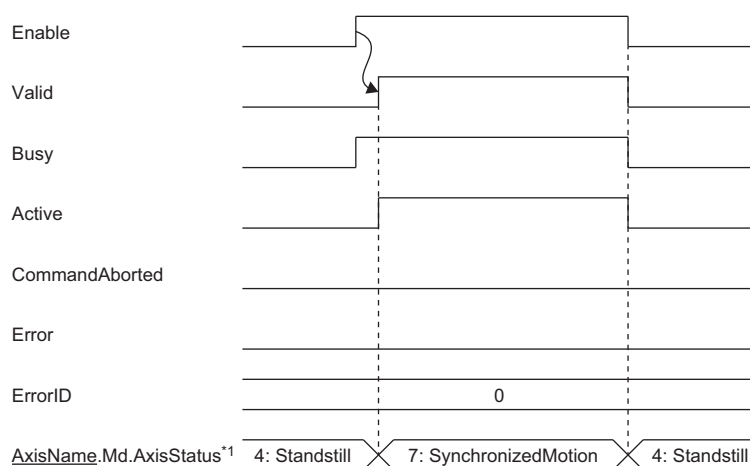
| Public variable  | Name                            | Data type | Default value | Description                                                                                                                                                                                                                                                     |
|------------------|---------------------------------|-----------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PurgedFilterPool | Disposed filter cumulated value | LREAL     | 0.0           | When Filter disable (FilterDisable) is set to TRUE, this variable stores the disposed value from Filter cumulated value (FilterPool).<br>Disposed filter cumulated value (PurgedFilterPool) is not cumulative.<br>The value is cleared to 0 at start of the FB. |

## Processing details

- This FB sets a specified control value to the input velocity of the master axis, and outputs the velocity of the set control value to the slave axis.
- Speed limit filter outputs the result of filter processing executed for the master axis (Master) value set in Master axis data source selection (MasterValueSource) to the slave axis (Slave).
- Axis status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "7: During synchronous operation (SynchronizedMotion)" during speed limit filter execution.
- If a speed limit filter is started while Slave axis (Slave) is in another operation FB, the start request will be ignored, and Start Not Possible (error code: 1AFCH) occurs. Start the speed limit filter when Axis status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "4: Standby (Standstill)".
- MC\_Stop (Forced Stop) is the only function block that can be multiple started during speed limit filter execution.
- When setting Enable (Enable) to FALSE, perform this function block while the slave axis is in stop status. If Enable (Enable) is set to FALSE while the slave axis is in operation, the slave axis will stop immediately.

## ■Timing chart

- When the processing is completed successfully



\*1 Axis status of Slave axis (Slave)

- When the processing is completed with an error

For the timing chart, refer to the following.

📖 Page 1435 Basic operation of Enable (Enable) type motion control FBs

### ■Filter disable (FilterDisable)

Sets the method used for the filter processing.

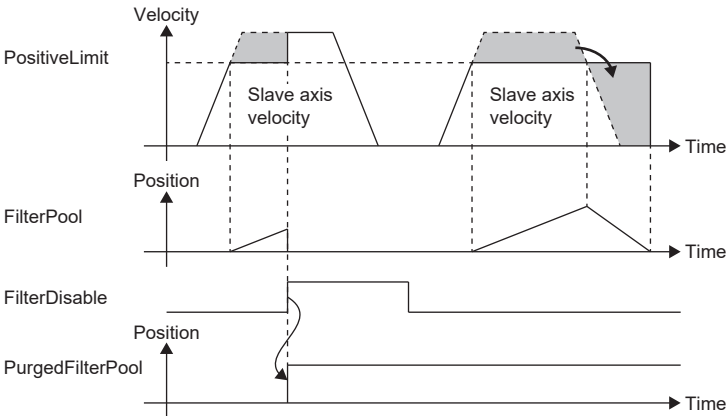
| Setting value | Description                                                                                      |
|---------------|--------------------------------------------------------------------------------------------------|
| FALSE         | Operates according to the filter setting.                                                        |
| TRUE          | Disables the filter and transmits the Master axis (Master) input to Slave axis (Slave) as it is. |

- When Filter disable (FilterDisable) is set to TRUE, the value in Filter cumulated value (FilterPool) becomes "0.0" and the disposed value from Filter cumulated value (FilterPool) is stored in Disposed filter cumulated value (PurgedFilterPool).

**Ex.**

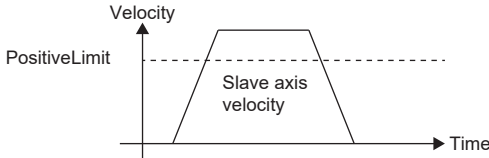
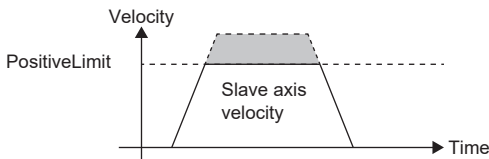
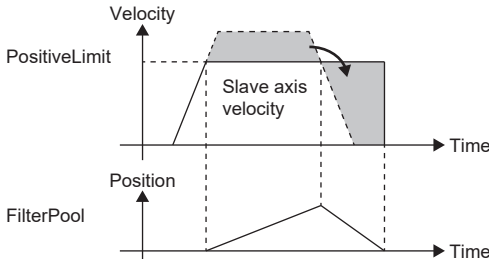
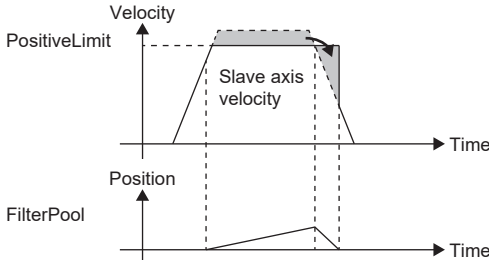
When set as shown below

| Input pin                                               | Setting value                                              |
|---------------------------------------------------------|------------------------------------------------------------|
| Positive direction filter operation<br>(PositiveFilter) | 4: Clamp (Without Ramp at Deceleration) (ClampWithoutRamp) |



## ■Positive direction filter operation (PositiveFilter)/Negative direction filter operation (NegativeFilter)

- Sets the slave axis operation at control based on the setting of Positive direction filter operation (PositiveFilter) and Negative direction filter operation (NegativeFilter).

| Setting value                                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Ignore (Ignore)                                         | <ul style="list-style-type: none"> <li>The velocity is not limited.</li> <li>Filter cumulated value (FilterPool) is not updated.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 2: Truncate (Truncate)                                     | <ul style="list-style-type: none"> <li>The amount exceeding the control value is not output to Slave axis (Slave).</li> <li>The restricted movement amount will be truncated, and the position relation between the master axis and the slave axis will deviate by the truncated amount.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 4: Clamp (Without Ramp at Deceleration) (ClampWithoutRamp) | <ul style="list-style-type: none"> <li>The amount exceeding the control value is cumulated as Filter cumulated value (FilterPool) and output later. The Filter cumulated value (FilterPool) output does not operate deceleration.</li> <li>When "0.0" is set as the control value, all the master axis input to the applicable direction will be cumulated as Filter cumulated value (FilterPool) and will not be output later to the slave axis. The cumulated amount will be subtracted by the reverse direction master axis input, and the slave axis will not operate until Filter cumulated value (FilterPool) is "0.0".</li> </ul> <p>■When Filter cumulated value is greater than the decelerated distance</p>  <p>■When Filter cumulated value is smaller than the decelerated distance</p>  |

- If a value outside the range is set in Filter operation (Filter), Out of Filter Operation Specification Range (error code: 1AE7H) occurs.

### ■ Master axis data source selection (MasterValueSource)

Slave axis (Slave) sets the position type of Master axis (Master) that will execute single axis synchronous control.

The operation may differ depending on the execution order of the FBs or if the operation cycles of Master axis (Master) and Slave axis (Slave) are different.

Operates with the same value as the set value when specifying Actual value in Master axis data source selection (MasterValueSource) while an axis type other than real axis is set in Master axis (Master).

| Setting value                                  | Description                                                                     |
|------------------------------------------------|---------------------------------------------------------------------------------|
| 1: Set value (mcSetValue)                      | Uses the commanded position of the master axis in the previous operation cycle. |
| 2: Actual value (mcActualValue)                | Uses the actual position of the master axis in the previous operation cycle.    |
| 101: Latest set value (mcLatestSetValue)       | Uses the commanded position of the master axis in the current operation cycle.  |
| 102: Latest actual value (mcLatestActualValue) | Uses the actual position of the master axis in the current operation cycle.     |

#### Point

When Master axis data source selection (MasterValueSource) is set to "1: Set value (mcSetValue)" or "101: Latest set value (mcLatestSetValue)" and the master axis becomes servo OFF by a servo alarm or forced stop, the amount of the value change may be too large. This can be prevented by setting Master axis data source selection (MasterValueSource) to "2: Actual value (mcActualValue)" or "102: Latest actual value (mcLatestActualValue)".

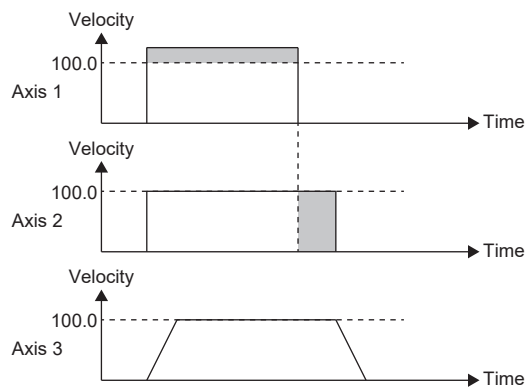
### Precautions

- If Filter disable (FilterDisable) is switched during operation, the Slave axis (Slave) velocity may change rapidly.
- After enabling the command filter, when the Master axis (Master) command is not transmitted to Slave axis (Slave) or the back part synchronous control FB because the stop factor occurred on Slave axis (Slave), the synchronous position relation deviates. Before enabling the command filter again, execute the synchronous positioning as needed.

## Program example

The following is a program example. The filter processing that restricts the velocity of the synchronous encoder is performed.

### • Operation



### • Settings

| Item                                              |                                | Setting value |
|---------------------------------------------------|--------------------------------|---------------|
| Positive direction/negative direction limit value | Positive direction limit value | 100.0         |
|                                                   | Negative direction limit value | 0.0           |
| Backlash amount                                   |                                | 1.0           |

### ■Axes

| Axis No. | Label name      | Data type | Comment |
|----------|-----------------|-----------|---------|
| 1        | EncoderAxis0001 | AXIS_REF  | Axis 1  |
| 2        | Axis0002        | AXIS_REF  | Axis 2  |
| 3        | Axis0003        | AXIS_REF  | Axis 3  |

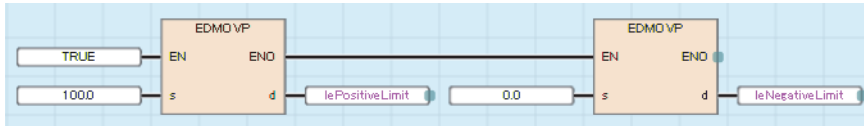
### ■Labels used

| Label name                | Data type                           | Comment                        |
|---------------------------|-------------------------------------|--------------------------------|
| MCv_SpeedLimitFilter_1    | MCv_SpeedLimitFilter                | Speed Limit Filter FB          |
| bSpeedLimitFilter         | Bit                                 | Speed limit filter command     |
| lePositiveLimit           | Double-precision real number        | Positive direction limit value |
| leNegativeLimit           | Double-precision real number        | Negative direction limit value |
| bSpeedLimitValid          | Bit                                 | Output value valid             |
| bSpeedLimitBusy           | Bit                                 | Executing                      |
| bSpeedLimitActive         | Bit                                 | Controlling                    |
| bSpeedLimitCommandAborted | Bit                                 | Abortion of execution          |
| bSpeedLimitError          | Bit                                 | Error                          |
| uwSpeedLimitErrorID       | Word [unsigned]/bit string [16-bit] | Error code                     |
| leFilterPool              | Double-precision real number        | Filter cumulated value         |
| MCv_SmoothingFilter_1     | MCv_SmoothingFilter                 | Smoothing Filter FB            |
| bSmoothingFilter          | Bit                                 | Smoothing filter command       |
| leFrequency               | Double-precision real number        | Frequency                      |
| bSmoothingValid           | Bit                                 | Output value valid             |
| bSmoothingInVelocity      | Bit                                 | Target velocity reached        |
| bSmoothingBusy            | Bit                                 | Executing                      |
| bSmoothingActive          | Bit                                 | Controlling                    |
| bSmoothingCommandAborted  | Bit                                 | Abortion of execution          |
| bSmoothingError           | Bit                                 | Error                          |
| uwSmoothingErrorID        | Word [unsigned]/bit string [16-bit] | Error code                     |
| leSmoothingValidFrequency | Double-precision real number        | Valid frequency                |
| leSmoothingFilterPool     | Double-precision real number        | Filter cumulated value         |

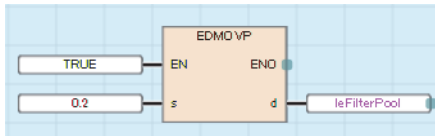


## ■ FBD/LD program

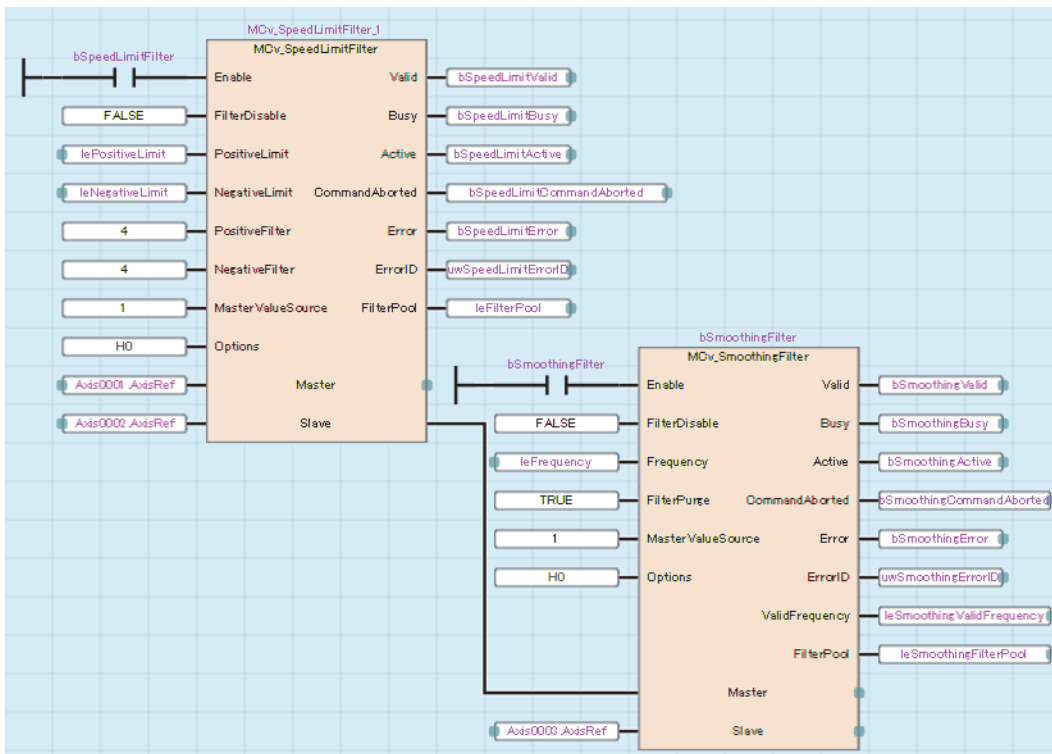
- Positive direction/negative direction limit value



- Frequency



- Speed Limit Filter/Smoothing Filter



## ■ST program

//-----Positive direction/negative direction limit value-----

lePositiveLimit:= 100.0;

leNegativeLimit:= 0.0;

//-----Speed Limit Filter-----

```
MCv_SpeedLimitFilter_1(  
  Master:= EncoderAxis0001.AxisRef ,  
  Slave:= Axis0002.AxisRef ,  
  Enable:= bSpeedLimitFilter ,  
  FilterDisable:= FALSE ,  
  PositiveLimit:= lePositiveLimit ,  
  NegativeLimit:= leNegativeLimit ,  
  PositiveFilter:= MC_VELOCITY_LIMIT_MODE__ClampWithoutRamp ,  
  NegativeFilter:= MC_VELOCITY_LIMIT_MODE__ClampWithoutRamp ,  
  MasterValueSource:= MC_SOURCE__mcSetValue ,  
  Options:= H00000000 ,  
  Valid=> bSpeedLimitValid ,  
  Busy=> bSpeedLimitBusy ,  
  Active=> bSpeedLimitActive ,  
  CommandAborted=> bSpeedLimitCommandAborted ,  
  Error=> bSpeedLimitError ,  
  ErrorID=> uwSpeedLimitErrorID ,  
  FilterPool=> leFilterPool  
);
```

//-----Frequency-----

leFrequency:= 0.20;

//-----Smoothing Filter-----

```
MCv_SmoothingFilter_1(  
  Master:= MCv_SpeedControl_1.Slave ,  
  Slave:= Axis0003.AxisRef ,  
  Enable:= bSmoothingFilter ,  
  FilterDisable:= FALSE ,  
  Frequency:= leFrequency ,  
  FilterPurge:= TRUE ,  
  MasterValueSource:= MC_SOURCE__mcSetValue ,  
  Options:= H00000000 ,  
  Valid=> bSmoothingValid ,  
  Busy=> bSmoothingBusy ,  
  Active=> bSmoothingActive ,  
  CommandAborted=> bSmoothingCommandAborted ,  
  Error=> bSmoothingError ,  
  ErrorID=> uwSmoothingErrorID ,  
  ValidFrequency=> leSmoothingValidFrequency ,  
  FilterPool=> leSmoothingFilterPool  
);
```

## 46.21 Axis Control Start Wait

46

### MCv\_MoveWait

This FB immediately performs the operation of the multiple-started motion FB for the specified axis by inputting an execution permission signal.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                   |
|--------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MCv_MoveWait(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ExecutionPermission:= ?MC_INPUT_REF? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   AnalysisComplete=&gt; ?BOOL? ); </pre> |

### Setting data

#### Input/output variable

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

#### Input variable

| Input variable      | Name                        | Data type    | Input    | Valid range | Default value         | Description                                                                     |
|---------------------|-----------------------------|--------------|----------|-------------|-----------------------|---------------------------------------------------------------------------------|
| Execute             | Execution command           | BOOL         | At start | TRUE, FALSE | FALSE                 | When this variable is TRUE, MCv_MoveWait (Axis control start wait) is executed. |
| ExecutionPermission | Execution permission signal | MC_INPUT_REF | At start | —           | Omission not possible | Sets a signal used for clearing axis control start wait.                        |
| Options             | Options                     | DWORD(HEX)   | At start | 00000000H   | 00000000H             | Set "00000000H".<br>An error occurs if a value other than "00000000H" is set.   |

## ■Output variable

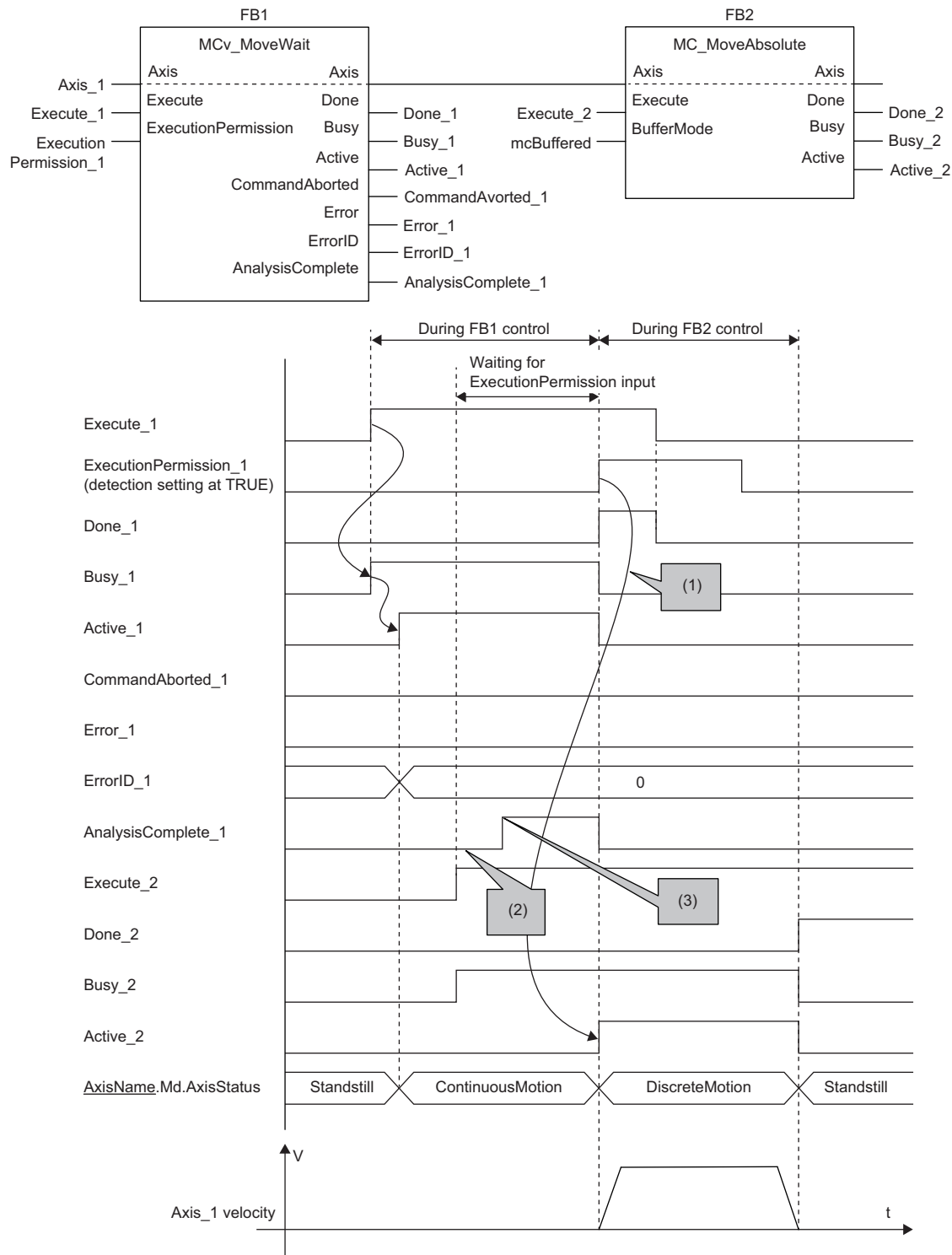
| Output variable  | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                            |
|------------------|-----------------------|------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done             | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when input detection of the signal set by ExecutionPermission (Execution permission signal) and AnalysisComplete (Analysis completion) become TRUE, indicating MCv_MoveWait (Axis control start wait) control is completed. |
| Busy             | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MCv_MoveWait (Axis control start wait) is being executed.                                                                                                                                                              |
| Active           | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MCv_MoveWait (Axis control start wait) is controlling the axis.                                                                                                                                                       |
| CommandAborted   | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution is aborted by another FB.                                                                                                                                                                                    |
| Error            | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                       |
| ErrorID          | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used          |
| AnalysisComplete | Analysis completion   | BOOL       | FALSE         | This variable becomes TRUE when the multiple-started motion FB analysis is complete.                                                                                                                                                                   |

## Processing details

- The axis operation of the multiple-started single axis control motion FB is immediately started when ExecutionPermission (Execution permission signal) is input.
- If another motion FB performs multiple start while MCv\_MoveWait (Axis control start wait) is in operation, the multiple-started FB is executed until analysis is complete and waits until ExecutionPermission (Execution permission signal) is input. The timing of completion of multiple-started FB analysis can be checked with AnalysisComplete (Analysis completion).
- Execute ExecutionPermission (Execution permission signal) after AnalysisComplete (Analysis completion) becomes TRUE.
- Axis status (AxisName.Md.AxisStatus) is "6: During continuous operation (ContinuousMotion)" until ExecutionPermission (Execution permission signal) is input.
- When ExecutionPermission (Execution permission signal) is input, the multiple-started FB is executed after one operation cycle from when the input signal is detected. At this time, Axis Status (AxisName.Md.AxisStatus) transits to the state according to the multiple-started FB.
- Input ExecutionPermission after AnalysisComplete becomes TRUE.

## ■ Timing chart

- When the processing is completed successfully



- (1) FB2 starts after one operation cycle when ExecutionPermission input is detected.  
 (2) Analysis of FB2 in progress  
 (3) Analysis of FB2 completed

- When the FB is completed with an error

For the timing chart, refer to the following.

📖 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■ExecutionPermission (Execution permission signal)

Specify a signal used for clearing MCv\_MoveWait (Axis control start wait).

ExecutionPermission (Execution permission signal) is set with an MC\_INPUT\_REF structure. For details on MC\_INPUT\_REF structures, refer to the following.

📖 Page 1487 MC\_INPUT\_REF

The following table shows the setting range for the input signal (ExecutionPermission.Signal) set in ExecutionPermission (Execution permission signal).

The type of input signal (ExecutionPermission.Signal) is SIGNAL\_SELECT structure.

| Structure                     | Variable name                                      | Type                                                    | Setting range                                                                                                                                                                                              |
|-------------------------------|----------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SIGNAL_SELECT (Signal select) | Source.Target (Signal)* <sup>1</sup>               | TARGET_REF<br>📖 Page 1489 TARGET_REF (Input signal)     | <b>■Type</b> <ul style="list-style-type: none"> <li>• BOOL</li> </ul> <b>■Data category</b> <ul style="list-style-type: none"> <li>• [OBJ]</li> <li>• [VAR]</li> <li>• [DEV]</li> <li>• [CONST]</li> </ul> |
|                               | Detection (Signal detection method)                | INT<br>(MC_SIGNAL_LOGIC)<br>📖 Page 1524 MC_SIGNAL_LOGIC | <ul style="list-style-type: none"> <li>• 0: Detection at TRUE (HighLevel)</li> <li>• 1: Detection at FALSE (LowLevel)</li> </ul>                                                                           |
|                               | CompensationTime (Compensation time)* <sup>2</sup> | LREAL                                                   | -5.0 to 0.0[s]                                                                                                                                                                                             |
|                               | FilterTime (Filter time)                           | LREAL                                                   | 0.0 to 5.0[s]                                                                                                                                                                                              |

\*1 An external signal high-accuracy input cannot be used. If a signal for an external signal high-accuracy input is specified, operation is performed with the same accuracy as a normal signal.

\*2 If a value smaller than one operation cycle is specified for Compensation time (ExecutionPermission.Signal.CompensationTime), operation is performed as 0.0 (no compensation).

When [OBJ] is specified, if the target modification is omitted, the object set in the target axis specified by the operand axis (Axis) is referred. However, if the axis set to Axis (Axis) does not have a station address or a station address has not been set, External signal selection incorrect (error code: 1B31H, 1B32H, 1BD6H, or 1BD7H) will be output.

When the station referred to when [OBJ] is specified has the Axis Emulate function enabled and also has a set station address, the emulating object will be referred.

To correct the advancement of ExecutionPermission (Execution permission signal) or adjust the execution timing of the multiple-started motion FB, set Compensation time (ExecutionPermission.Signal.CompensationTime).

To prevent signal misdetection caused by the chattering of ExecutionPermission (Execution permission signal), set Filter time (ExecutionPermission.Signal.FilterTime).

When a signal that cannot be used for Signal name (ExecutionPermission.Signal.Source.Target) is used, one of the following errors will be output: External signal selection string incorrect (error code: 1B05H), External signal selection incorrect (error code: 1B31H, 1B32H, 1BD6H, or 1BD7H), or Add-on Signal IO internal error (error code: 1B33H, 1BD8H).

## Precautions

- Input ExecutionPermission (execution permission signal) after AnalysisComplete becomes TRUE. If no multiple-started motion FB exists or if analysis is not completed (when AnalysisComplete (Analysis completion) is FALSE), even if the input of ExecutionPermission (Execution permission signal) is detected, Done (Execution completion) does not become TRUE.
- Perform multiple start with the motion FB after Active (Executing) of MCv\_MoveWait (Axis control start wait) becomes TRUE. If an error occurs while MCv\_MoveWait (Axis control start wait) is being executed, a multiple-started motion FB may be executed without waiting for the input of ExecutionPermission (Execution permission signal).
- When using the mixed operation cycles function, the operation cycle of the MCv\_MoveWait (Axis control start wait) target axis and the refresh cycle of ExecutionPermission (Execution permission signal) must be the same. If the refresh cycle is different, the positioning start timing may become irregular.
- To start axes with different operation cycles at the same time, set the same operation cycle to each axis. Otherwise, the axis start timing may deviate by one operation cycle. To start axes with different operation cycles at the same time, use multiple signals of ExecutionPermission (Execution permission signal) with the same Signal name (ExecutionPermission.Signal.Source.Target) and the same Signal logic (ExecutionPermission.Signal.Detection) set, and adjust the Compensation time (ExecutionPermission.Signal.CompensationTime).
- When executing MCv\_MoveWait (axis control start wait), check that Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)". If Axis status (AxisName.Md.AxisStatus) is unable to start, Start Not Possible (error code: 1AFCH) occurs, and control in operation stops.
- If MCv\_MoveWait (axis control start wait) is started while another operation system FB is running, the start request will be ignored and Start during Operation Warning (event code: 00D01H) will occur.
- Set Buffered to Buffer mode (BufferMode) for the multiple start motion FB. If multiple start is performed by setting Aborting, MCv\_MoveWait (Axis control start wait) is aborted, the input status of ExecutionPermission (Execution permission signal) is ignored, and the multiple-started motion FB is executed immediately. If multiple start is performed when Blending is set, BufferMode specification not allowed (Error code: 1AE5H) occurs.

## Program example

The following is a program example. By setting Control start (bExecute) to TRUE, MC\_MoveRelative and MCv\_MoveLinearInterpolateRelative are analyzed and put in standby, and by setting Execution permission signal (bExecutionPermission) to TRUE, the FBs that are in standby mode are started at the same time.

### ■Axis

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REAL | Axis 1  |
| 2        | Axis0002   | AXIS_REAL | Axis 2  |
| 3        | Axis0003   | AXIS_REAL | Axis 3  |

### ■Axes group

| Axes group No. | Label name    | Data type  | Comment      |
|----------------|---------------|------------|--------------|
| 1              | AxisGroup0001 | AXIS_GROUP | Axes group 1 |

| Item                  | Setting value |
|-----------------------|---------------|
| Configuration axis[1] | Axis0001      |
| Configuration axis[2] | Axis0002      |

### ■I/O data

| Label name     | Data category | Data type    | Source type | Source               | Signal detection method | Compensation time | Filter time |
|----------------|---------------|--------------|-------------|----------------------|-------------------------|-------------------|-------------|
| SignalData0001 | Input signal  | MC_INPUT_REF | Label       | bExecutionPermission | HighLevel               | 0.0               | 0.0         |

### ■Labels used

| Label name                               | Data type                           | Comment                                        |
|------------------------------------------|-------------------------------------|------------------------------------------------|
| bExecute                                 | Bit                                 | Control start                                  |
| bExecutionPermission                     | Bit                                 | Execution permission signal                    |
| MCv_MoveWait_1                           | MCv_MoveWait                        | Axis control start wait FB                     |
| MC_MoveRelative_1                        | MC_MoveRelative                     | Relative Value Positioning FB                  |
| MCv_GroupMoveWait_1                      | MCv_GroupMoveWait                   | Axes group control start wait FB               |
| MCv_MoveLinearInterpolateRelative_1      | MCv_MoveLinearInterpolateRelative   | Relative Value Linear Interpolation Control FB |
| wMoveLinearInterpolateRelativeLinearAxes | Word [signed](0..15)                | Linear interpolation axis                      |
| leMoveLinearInterpolateRelativePosition  | Double-precision real number(0..15) | Target position                                |



## ■ST program

```

SET( MCv_MoveWait_1.Active , bMoveRelativeExecute );
SET( MCv_GroupMoveWait_1.Active , bMoveLinearInterpolateRelativeExecute );
RST( NOT bExecute , bMoveRelativeExecute );
RST( NOT bExecute , bMoveLinearInterpolateRelativeExecute );
//-----Axis control start wait-----
MCv_MoveWait_1(
    Axis:= Axis0001.AxisRef ,
    Execute:= bExecute ,
    ExecutionPermission:= SignalData0001 ,
    Options:= H00000000
);
//-----Relative value positioning-----
MC_MoveRelative_1(
    Axis:= Axis0001.AxisRef ,
    Execute:= bMoveRelativeExecute ,
    ContinuousUpdate:= FALSE ,
    Distance:= 10000.0 ,
    Velocity:= 1000.0 ,
    Acceleration:= 1000.0 ,
    Deceleration:= 1000.0 ,
    Jerk:= 0.0 ,
    BufferMode:= MC_BUFFER_MODE__mcBuffered ,
    Options:= H00000000
);
//-----Axes group control start wait-----
MCv_GroupMoveWait_1(
    AxesGroup:= AxesGroup001.AxesGroupRef ,
    Execute:= bExecute ,
    ExecutionPermission:= SignalData0001 ,
    Options:= H00000000
);
//-----Data setting for relative value linear interpolation control-----
wMoveLinearInterpolateRelativeLinearAxes[0] := 1;
wMoveLinearInterpolateRelativeLinearAxes[1] := 2;
leMoveLinearInterpolateRelativeDistance[0] := 10000.0;
leMoveLinearInterpolateRelativeDistance[1] := 10000.0;
//-----Relative value linear interpolation control-----
MCv_MoveLinearInterpolateRelative_1(
    AxesGroup:= AxesGroup001.AxesGroupRef ,
    Execute:= bMoveLinearInterpolateRelativeExecute ,
    ContinuousUpdate:= FALSE ,
    LinearAxes:= wMoveLinearInterpolateRelativeLinearAxes ,
    Distance:= leMoveLinearInterpolateRelativeDistance ,
    Velocity:= 1000.0 ,
    Acceleration:= 1000.0 ,
    Deceleration:= 1000.0 ,
    Jerk:= 0.0 ,
    VelocityMode:= MC_INTERPOLATE_SPEED_MODE__VectorSpeed ,
    BufferMode:= MC_BUFFER_MODE__mcBuffered ,
    Options:= H00000000
);

```

## 46.22 Axes Group Control Start Wait

### MCv\_GroupMoveWait

This FB immediately performs the operation of the multiple-started motion FB for the specified axes group by inputting an execution permission signal.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                   |
|--------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MCv_GroupMoveWait(   AxesGroup:= ?AXES_GROUP_REF? ,   Execute:= ?BOOL? ,   ExecutionPermission:= ?MC_INPUT_REF? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   AnalysisComplete=&gt; ?BOOL? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name                   | Data type      | Input    | Valid range | Default value         | Description                                                                                                                                                                                |
|--------------|------------------------|----------------|----------|-------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxesGroup    | Axes group information | AXES_GROUP_REF | At start | —           | Omission not possible | An axes group is set.<br>For the variable ( <u>AxesGroupName.AxesGroupRef.</u> ) used, refer to the following.<br>Page 1468<br><u>AxesGroupName.AxesGroupRef.</u> (Axes group information) |

#### Input variable

| Input variable      | Name                        | Data type    | Input    | Valid range | Default value         | Description                                                                                |
|---------------------|-----------------------------|--------------|----------|-------------|-----------------------|--------------------------------------------------------------------------------------------|
| Execute             | Execution command           | BOOL         | At start | TRUE, FALSE | FALSE                 | When this variable is TRUE, MCv_GroupMoveWait (Axes group control start wait) is executed. |
| ExecutionPermission | Execution permission signal | MC_INPUT_REF | At start | —           | Omission not possible | Sets a signal used for clearing axes group control start wait.                             |
| Options             | Options                     | DWORD(HEX)   | At start | 00000000H   | 00000000H             | Set "00000000H".<br>An error occurs if a value other than "00000000H" is set.              |

## ■Output variable

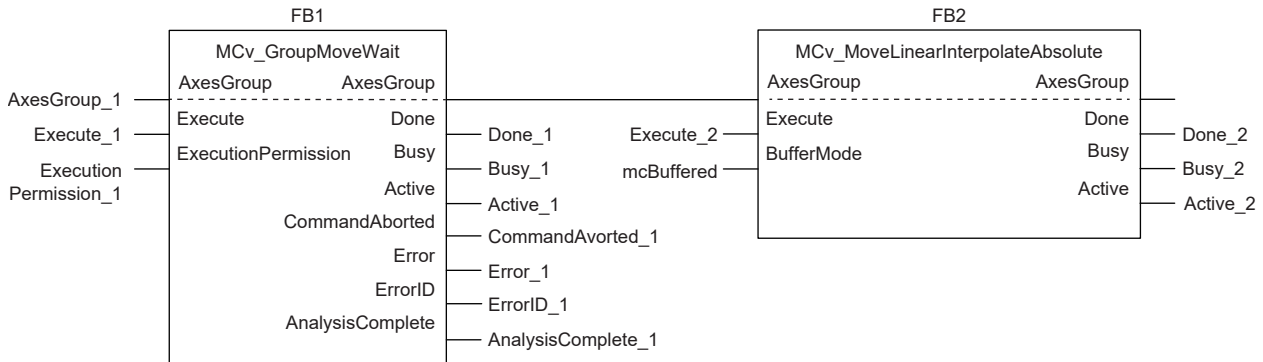
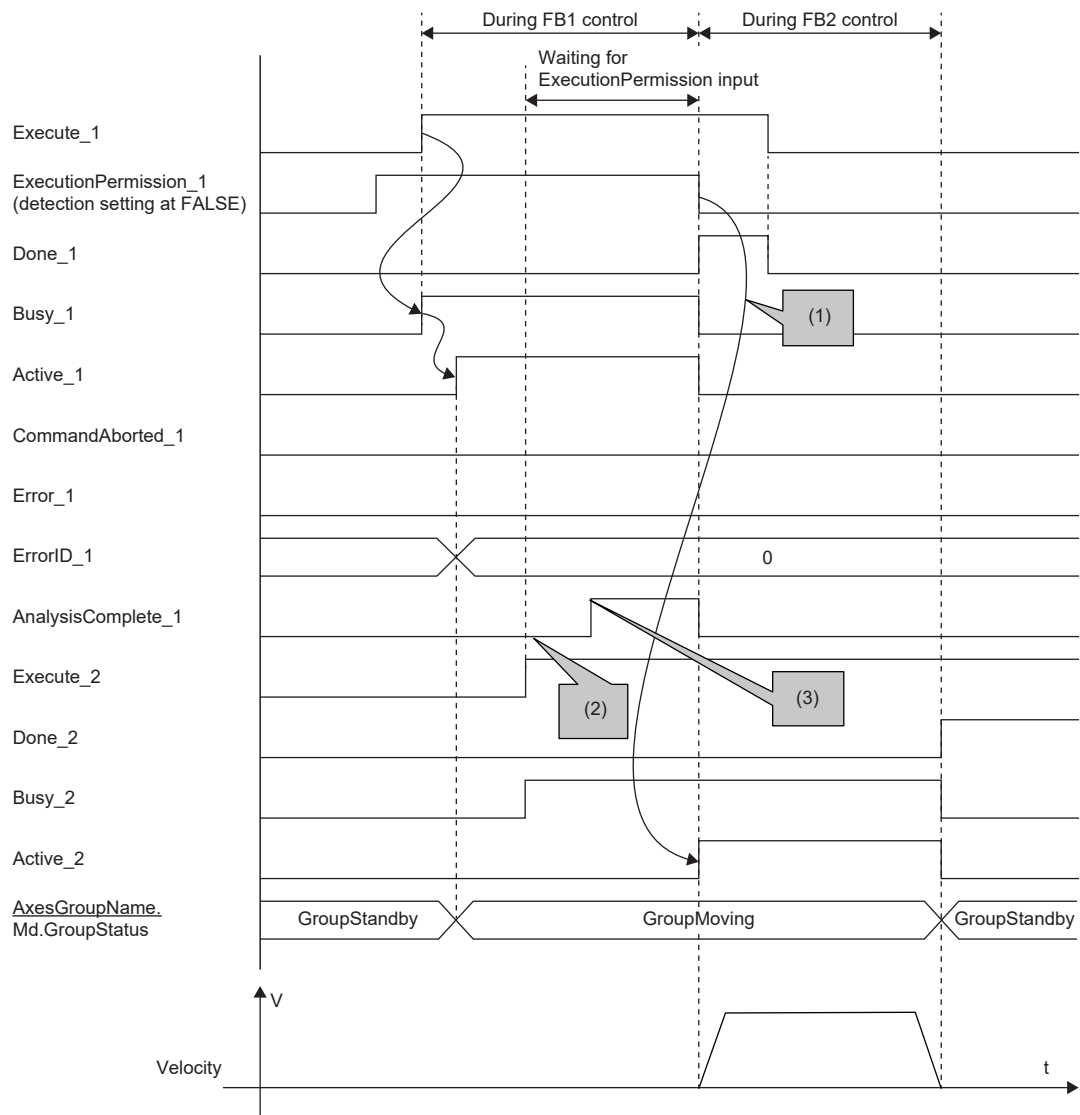
| Output variable  | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                                 |
|------------------|-----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done             | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when the input of the signal set by ExecutionPermission (Execution permission signal) and AnalysisComplete (Analysis completion) become TRUE, indicating MCv_GroupMoveWait (Axes group control start wait) control is completed. |
| Busy             | Executing             | BOOL       | FALSE         | This variable becomes TRUE when MCv_GroupMoveWait (Axes group control start wait) is being executed.                                                                                                                                                        |
| Active           | Controlling           | BOOL       | FALSE         | This variable becomes TRUE while MCv_GroupMoveWait (Axes group control start wait) is controlling the axes.                                                                                                                                                 |
| CommandAborted   | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution is aborted by another FB.                                                                                                                                                                                         |
| Error            | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                            |
| ErrorID          | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used               |
| AnalysisComplete | Analysis completion   | BOOL       | FALSE         | This variable becomes TRUE when the multiple-started motion FB analysis is complete.                                                                                                                                                                        |

## Processing details

- The axes group operation of a multiple-started multi-axis control motion FB is immediately executed when ExecutionPermission (Execution permission signal) is input.
- If another motion FB performs multiple start while MCv\_GroupMoveWait (Axes group control start wait) is in operation, the multiple-started FB is executed until analysis is complete and waits until ExecutionPermission (Execution permission signal) is input. The timing of completion of multiple-started FB analysis can be checked with AnalysisComplete (Analysis completion).
- Execute ExecutionPermission (Execution permission signal) after AnalysisComplete (Analysis completion) becomes TRUE.
- Axes group status (AxisGroupName.Md.GroupStatus) is "5: Operating (GroupMoving)" until ExecutionPermission (Execution permission signal) is input.
- When ExecutionPermission (Execution permission signal) is input, the multiple-started FB is executed after one operation cycle from when the input signal is detected.
- Input ExecutionPermission after AnalysisComplete becomes TRUE.

## ■ Timing chart

- When the processing is completed successfully



- (1) FB2 starts after one operation cycle when ExecutionPermission input is detected.  
 (2) Analysis of FB2 in progress  
 (3) Analysis of FB2 completed

- When the FB is completed with an error

For the timing chart, refer to the following.

☞ Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■ExecutionPermission (Execution permission signal)

Specify a signal used for clearing MCv\_GroupMoveWait (Axes group control start wait).

ExecutionPermission (Execution permission signal) is set with an MC\_INPUT\_REF structure. For details on MC\_INPUT\_REF structures, refer to the following.

📖 Page 1487 MC\_INPUT\_REF

The following table shows the setting range for the input signal (ExecutionPermission.Signal) set in ExecutionPermission (Execution permission signal).

The type of input signal (ExecutionPermission.Signal) is SIGNAL\_SELECT structure.

| Structure                     | Variable name                                      | Type                                                    | Setting range                                                                                                                                                         |
|-------------------------------|----------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SIGNAL_SELECT (Signal select) | Source.Target (Signal)* <sup>1</sup>               | TARGET_REF<br>📖 Page 1489 TARGET_REF (Input signal)     | <ul style="list-style-type: none"> <li>■Type</li> <li>• BOOL</li> <li>■Data category</li> <li>• [OBJ]</li> <li>• [VAR]</li> <li>• [DEV]</li> <li>• [CONST]</li> </ul> |
|                               | Detection (Signal detection method)                | INT<br>(MC_SIGNAL_LOGIC)<br>📖 Page 1524 MC_SIGNAL_LOGIC | <ul style="list-style-type: none"> <li>• 0: Detection at TRUE (HighLevel)</li> <li>• 1: Detection at FALSE (LowLevel)</li> </ul>                                      |
|                               | CompensationTime (Compensation time)* <sup>2</sup> | LREAL                                                   | -5.0 to 0.0[s]                                                                                                                                                        |
|                               | FilterTime (Filter time)                           | LREAL                                                   | 0.0 to 5.0[s]                                                                                                                                                         |

\*1 An external signal high-accuracy input cannot be used. If a signal for an external signal high-accuracy input is specified, operation is performed with the same accuracy as a normal signal.

\*2 If a value smaller than one operation cycle is specified for Compensation time (ExecutionPermission.Signal.CompensationTime), operation is performed as 0.0 (no compensation).

When [OBJ] is specified, if the target modification is omitted, External signal selection incorrect (error code: 1B31H, 1B32H, 1BD6H, or 1BD7H) is output.

When the station referred to when [OBJ] is specified has the Axis Emulate function enabled and also has a set station address, the emulating object will be referred.

To correct the advancement of ExecutionPermission (Execution permission signal) and adjust the execution timing of the multiple-started motion FB, set Compensation time (ExecutionPermission.Signal.CompensationTime).

To prevent signal misdetection caused by the chattering of ExecutionPermission (Execution permission signal), set Filter time (ExecutionPermission.Signal.FilterTime).

When a signal that cannot be used for Signal name (ExecutionPermission.Signal.Source.Target) is used, one of the following errors will be output: External signal selection string incorrect (error code: 1B05H), External signal selection incorrect (error code: 1B31H, 1B32H, 1BD6H, or 1BD7H), or Add-on Signal IO internal error (error code: 1B33H, 1BD8H).

## Precautions

- Input ExecutionPermission (execution permission signal) after AnalysisComplete becomes TRUE. If no multiple-started motion FB exists or if analysis is not completed (when AnalysisComplete (Analysis completion) is FALSE), even if the input of ExecutionPermission (Execution permission signal) is detected, Done (Execution completion) does not become TRUE.
- Perform multiple start with the motion FB after Active (Executing) of MCv\_GroupMoveWait (Axes group control start wait) becomes TRUE. If an error occurs while MCv\_GroupMoveWait (Axes group control start wait) is being executed, a multiple-started motion FB may be executed without waiting for the input of ExecutionPermission (Execution permission signal).
- When using the mixed operation cycles function, the operation cycle of the MCv\_GroupMoveWait (Axes group control start wait) target axis and the refresh cycle of ExecutionPermission (Execution permission signal) must be the same. If the refresh cycle is different, the positioning start timing may become irregular.
- To start axes with different operation cycles at the same time, set the same operation cycle to each axis. Otherwise, the axis start timing may deviate by one operation cycle. To start axes with different operation cycles at the same time, use multiple signals of ExecutionPermission (Execution permission signal) with the same Signal name (ExecutionPermission.Signal.Source.Target) and the same Signal logic (ExecutionPermission.Signal.Detection) set, and adjust the Compensation time (ExecutionPermission.Signal.CompensationTime).
- When executing MCv\_GroupMoveWait (Axes group control start wait), check that Axes group status (AxisGroupName.Md.GroupStatus) is "4: Standby (GroupStandby)". If Axes group status (AxisGroupName.Md.GroupStatus) is unable to start, Start Not Possible (error code: 1AFCH) occurs, and control in operation stops.
- If MCv\_GroupMoveWait (axes group control start wait) is started while another operation system FB is running, the start request will be ignored and Start during Operation Warning (event code: 00D01H) will occur.
- Set Buffered to Buffer mode (BufferMode) for the multiple start motion FB. If multiple start is performed by setting Aborting, MCv\_GroupMoveWait (Axes group control start wait) is aborted, the input status of ExecutionPermission (Execution permission signal) is ignored, and the multiple-started motion FB is executed immediately. If multiple start is performed when Blending is set, BufferMode specification not allowed (Error code: 1AE5H) occurs.

## Program example

The following is a program example. By setting Control start (bExecute) to TRUE, MC\_MoveRelative and MCv\_MoveLinearInterpolateRelative are analyzed and put in standby, and by setting Execution permission signal (bExecutionPermission) to TRUE, the FBs that are in standby mode are started at the same time.

### ■Axis

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001   | AXIS_REAL | Axis 1  |
| 2        | Axis0002   | AXIS_REAL | Axis 2  |
| 3        | Axis0003   | AXIS_REAL | Axis 3  |

### ■Axes group

| Axes group No. | Label name    | Data type  | Comment      |
|----------------|---------------|------------|--------------|
| 1              | AxisGroup0001 | AXIS_GROUP | Axes group 1 |

| Item                  | Setting value |
|-----------------------|---------------|
| Configuration axis[1] | Axis0001      |
| Configuration axis[2] | Axis0002      |

### ■I/O data

| Label name     | Data category | Data type    | Source type | Source               | Signal detection method | Compensation time | Filter time |
|----------------|---------------|--------------|-------------|----------------------|-------------------------|-------------------|-------------|
| SignalData0001 | Input signal  | MC_INPUT_REF | Label       | bExecutionPermission | HighLevel               | 0.0               | 0.0         |

### ■Labels used

| Label name                               | Data type                           | Comment                                        |
|------------------------------------------|-------------------------------------|------------------------------------------------|
| bExecute                                 | Bit                                 | Control start                                  |
| bExecutionPermission                     | Bit                                 | Execution permission signal                    |
| MCv_MoveWait_1                           | MCv_MoveWait                        | Axis control start wait FB                     |
| MC_MoveRelative_1                        | MC_MoveRelative                     | Relative Value Positioning FB                  |
| MCv_GroupMoveWait_1                      | MCv_GroupMoveWait                   | Axes group control start wait FB               |
| MCv_MoveLinearInterpolateRelative_1      | MCv_MoveLinearInterpolateRelative   | Relative Value Linear Interpolation Control FB |
| wMoveLinearInterpolateRelativeLinearAxes | Word [signed](0..15)                | Linear interpolation axis                      |
| leMoveLinearInterpolateRelativePosition  | Double-precision real number(0..15) | Target position                                |

## ■ST program

```
SET( MCv_MoveWait_1.Active , bMoveRelativeExecute );
SET( MCv_GroupMoveWait_1.Active , bMoveLinearInterpolateRelativeExecute );
RST( NOT bExecute , bMoveRelativeExecute );
RST( NOT bExecute , bMoveLinearInterpolateRelativeExecute );
//-----Axis control start wait-----
MCv_MoveWait_1(
    Axis:= Axis0001.AxisRef ,
    Execute:= bExecute ,
    ExecutionPermission:= SignalData0001 ,
    Options:= H00000000
);
//-----Relative value positioning-----
MC_MoveRelative_1(
    Axis:= Axis0001.AxisRef ,
    Execute:= bMoveRelativeExecute ,
    ContinuousUpdate:= FALSE ,
    Distance:= 10000.0 ,
    Velocity:= 1000.0 ,
    Acceleration:= 1000.0 ,
    Deceleration:= 1000.0 ,
    Jerk:= 0.0 ,
    BufferMode:= MC_BUFFER_MODE__mcBuffered ,
    Options:= H00000000
);
//-----Axes group control start wait-----
MCv_GroupMoveWait_1(
    AxesGroup:= AxesGroup001.AxesGroupRef ,
    Execute:= bExecute ,
    ExecutionPermission:= SignalData0001 ,
    Options:= H00000000
);
//-----Data setting for relative value linear interpolation control-----
wMoveLinearInterpolateRelativeLinearAxes[0] := 1;
wMoveLinearInterpolateRelativeLinearAxes[1] := 2;
leMoveLinearInterpolateRelativeDistance[0] := 10000.0;
leMoveLinearInterpolateRelativeDistance[1] := 10000.0;
//-----Relative value linear interpolation control-----
MCv_MoveLinearInterpolateRelative_1(
    AxesGroup:= AxesGroup001.AxesGroupRef ,
    Execute:= bMoveLinearInterpolateRelativeExecute ,
    ContinuousUpdate:= FALSE ,
    LinearAxes:= wMoveLinearInterpolateRelativeLinearAxes ,
    Distance:= leMoveLinearInterpolateRelativeDistance ,
    Velocity:= 1000.0 ,
    Acceleration:= 1000.0 ,
    Deceleration:= 1000.0 ,
    Jerk:= 0.0 ,
    VelocityMode:= MC_INTERPOLATE_SPEED_MODE__VectorSpeed ,
    BufferMode:= MC_BUFFER_MODE__mcBuffered ,
    Options:= H00000000
);
```



# 46.23 Advanced Synchronous Control

46

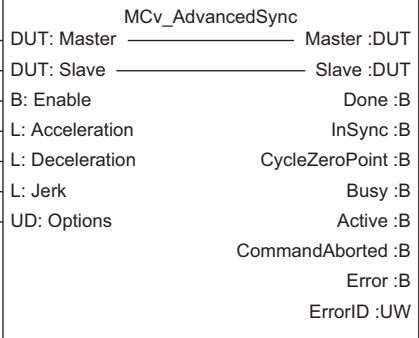
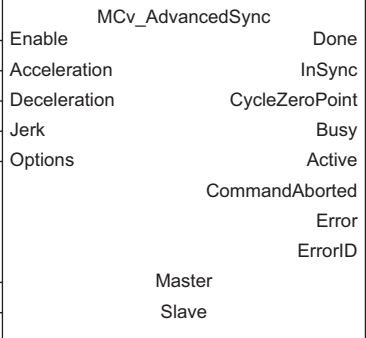
## MCv\_AdvancedSync

This FB starts synchronous control according to the specified advanced synchronous control settings.

### Restriction

Before using this FB, check the versions of the controller and engineering tool.

 User's manual for the controller used

| Ladder diagram                                                                    | FBD/LD                                                                             | ST                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | <pre> MCv_AdvancedSync(   Master:= ?AXIS_REF? ,   Slave:= ?AXIS_REF? ,   Enable:= ?BOOL? ,   Acceleration:= ?LREAL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   InSync=&gt; ?BOOL? ,   CycleZeroPoint=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name        | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                                                                                                         |
|--------------|-------------|-----------|----------|-------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Master       | Master axis | AXIS_REF  | At start | —           | Omission not possible | The input axis is set.<br>If the value is omitted, Out of master axis No. range (error code: 1B0BH or 1B85H) occurs.<br>If no corresponding input setting exists, Advanced synchronization control axis unset (error code: 1B22H) occurs at start.  |
| Slave        | Slave axis  | AXIS_REF  | At start | —           | Omission not possible | The output axis is set.<br>If the value is omitted, Out of slave axis No. range (error code: 1B0CH or 1B86H) occurs.<br>If no corresponding output setting exists, Advanced synchronization control axis unset (error code: 1B22H) occurs at start. |

## ■Input variables

| Input variable | Name         | Data type  | Input    | Valid range                                                                                                                              | Default value | Description                                                                                                                                                                                                                        |
|----------------|--------------|------------|----------|------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Enable         | Enable       | BOOL       | Always   | TRUE, FALSE                                                                                                                              | FALSE         | This FB is executed when the value is set to TRUE.                                                                                                                                                                                 |
| Acceleration   | Acceleration | LREAL      | At start | 0.0                                                                                                                                      | 0.0           | Set "0.0".<br>If a value other than "0.0" is set, Out of acceleration range (error code: 1A8DH) occurs.                                                                                                                            |
| Deceleration   | Deceleration | LREAL      | At start | 0.0000, 0.0001 to 2147483647.0                                                                                                           | 0.0           | The deceleration is set.<br>For details, refer to the following.<br> Page 1907 Deceleration (Deceleration)                                      |
| Jerk           | Jerk         | LREAL      | At start | 0.0                                                                                                                                      | 0.0           | Set "0.0".<br>If a value other than "0.0" is set, Out of jerk range (error code: 1A8FH) occurs.                                                                                                                                    |
| Options        | Options      | DWORD(HEX) | At start | Refer to the following.<br> Page 1907 Options (Options) | 00000000H     | The function options for this FB are set in the specified bit position.<br>For details, refer to the following.<br> Page 1907 Options (Options) |

## ■Output variables

| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------|-----------------------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Execution completion  | BOOL       | FALSE         | This variable becomes TRUE when any of the following conditions are met.<br>• After the execution status is transitioned from this FB to the next motion control FB in which multiple start (buffer mode) is set to "1: Buffered"<br>• When the analysis in synchronous control analysis mode is completed                                                                                          |
| InSync          | In synchronization    | BOOL       | FALSE         | This variable becomes TRUE when the output axis starts synchronization.                                                                                                                                                                                                                                                                                                                             |
| CycleZeroPoint  | Cam cycle completion  | BOOL       | FALSE         | This variable becomes TRUE whenever the current position per cycle exceeds the permissible range, when the target is a linear cam, or when a cam whose cam start point is "0" is used after Controlling (Active) becomes TRUE.<br>This variable becomes TRUE when the current position per cycle passes the cam data 0th-point position when a cam whose cam start point is other than "0" is used. |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when this FB is executed.                                                                                                                                                                                                                                                                                                                                                |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE when this FB is controlling the axis.                                                                                                                                                                                                                                                                                                                                    |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution of this FB is aborted.<br>The variable becomes FALSE if Enable (Enable) becomes FALSE.                                                                                                                                                                                                                                                                    |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                                                                    |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                                                                                                                                   |

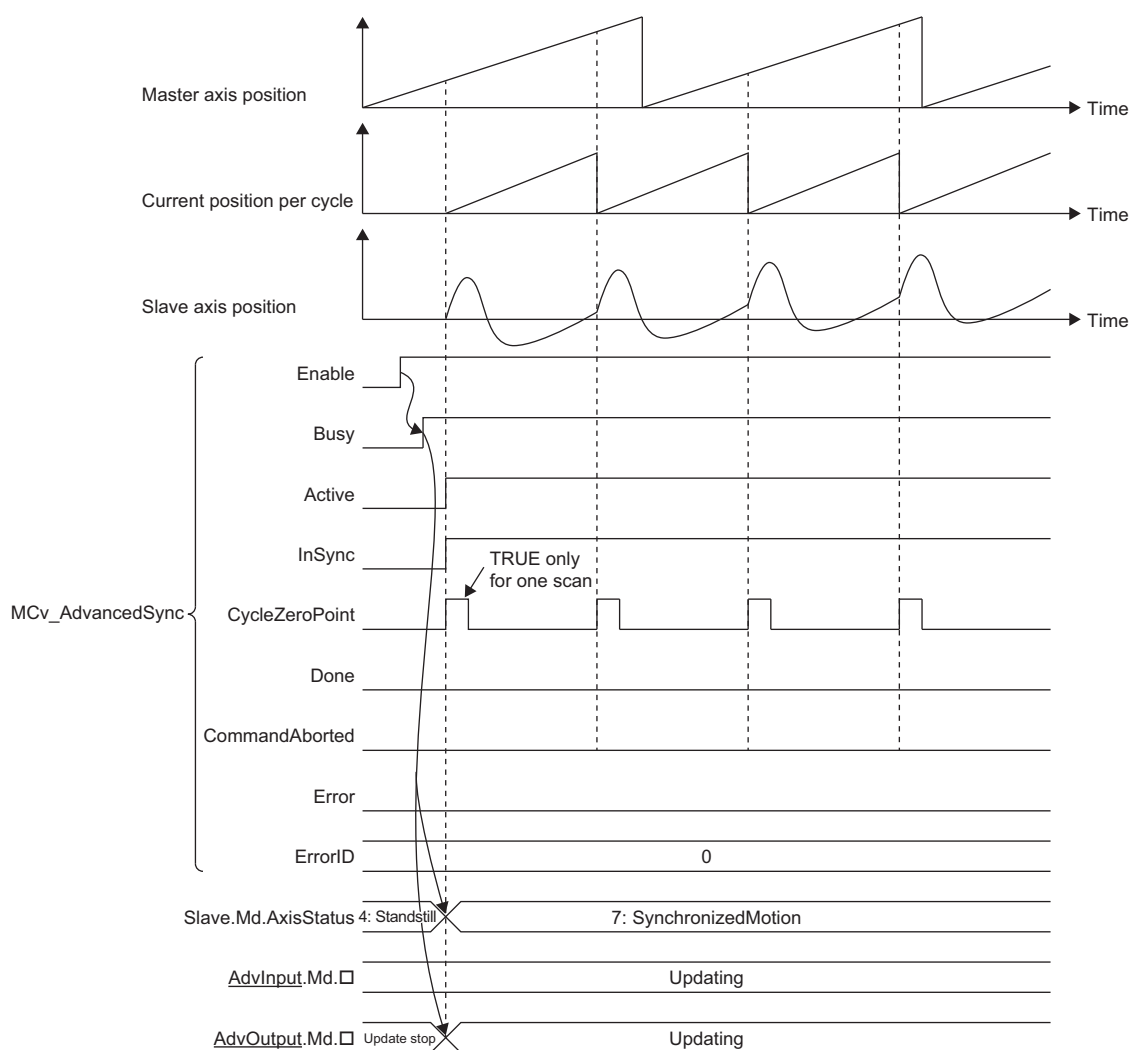
## Processing details

- When this FB is executed, it starts advanced synchronous control according to the specified advanced synchronous control settings.
- Synchronous control can only be started when Axis status (AxisName.Md.AxisStatus) of the slave axis is "4: Standby (Standstill)". When control is started, Axis status (AxisName.Md.AxisStatus) of the slave axis changes to "7: During synchronous operation (SynchronizedMotion)". When synchronous control is started, if "4: Standby (Standstill)" is not set, Axis status (AxisName.Md.AxisStatus) of the slave axis becomes "1: Stopping on error (ErrorStop)" and Start not possible (error code: 1AFCH) occurs.
- If Enable (Enable) of this FB is set to FALSE, or a stop cause occurs in the axis set in the axis information on the output axis, Slave axis (Slave) immediately stops or is decelerated to stop according to the stop cause and its stop processing.
- For details on advanced synchronous control, refer to the following.

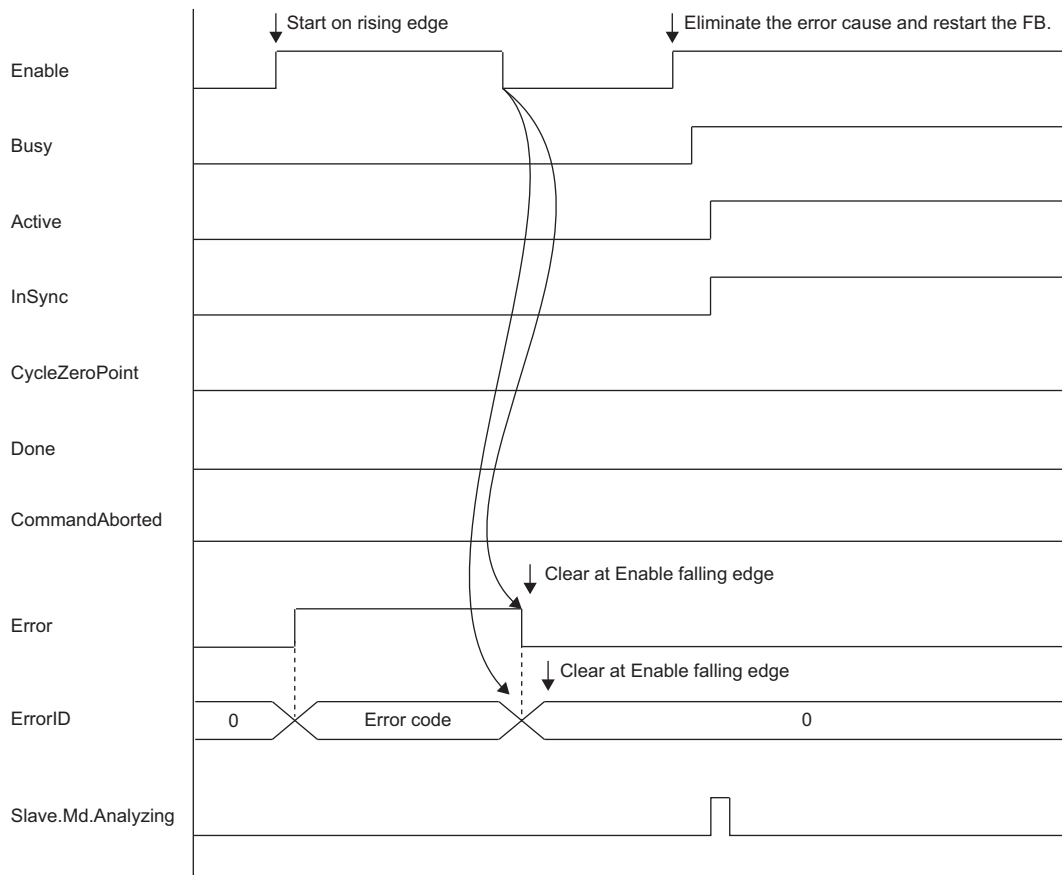
📖 User's manual for the controller used

### ■ Timing chart

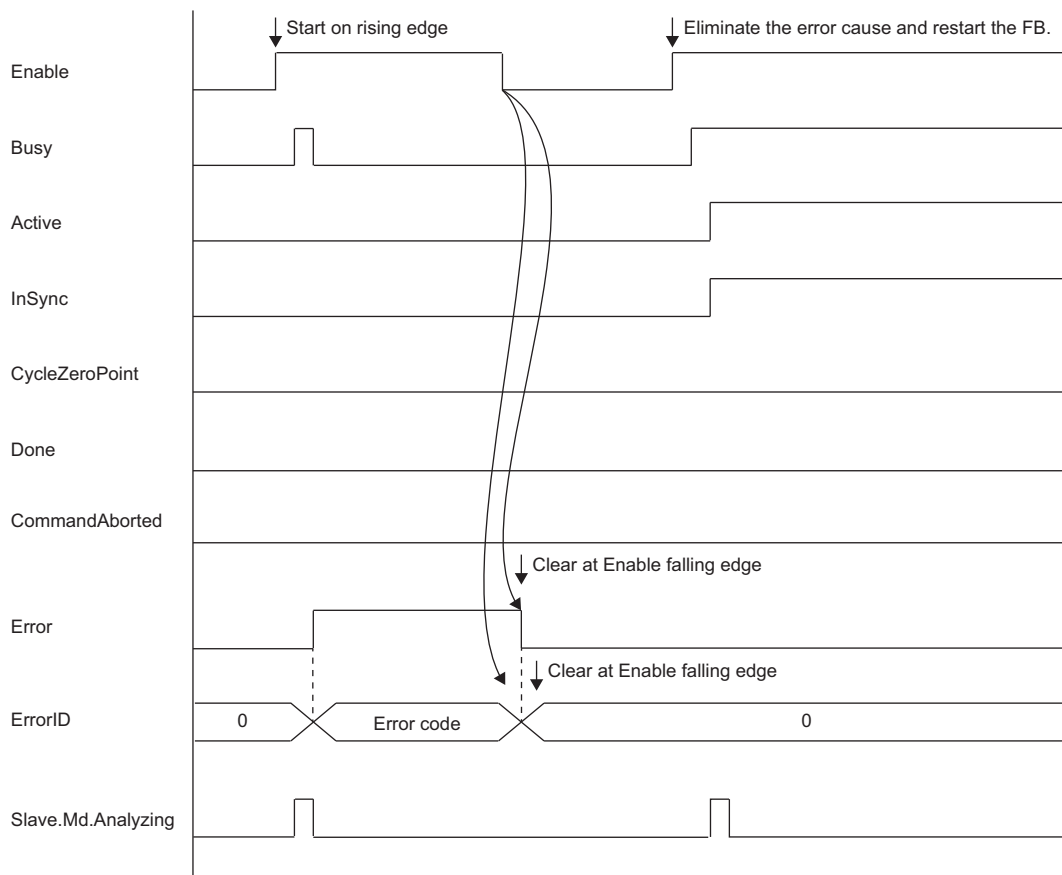
- When the processing is completed successfully



- When I/O variables are abnormal



- When an input variable is abnormal



## ■Deceleration (Deceleration)

The deceleration is set.

Specify the setting range if Acceleration/deceleration method setting (Options (Options): Bit 0 to 1) is set to "0: Acceleration/deceleration specification method (mcAccDec)".

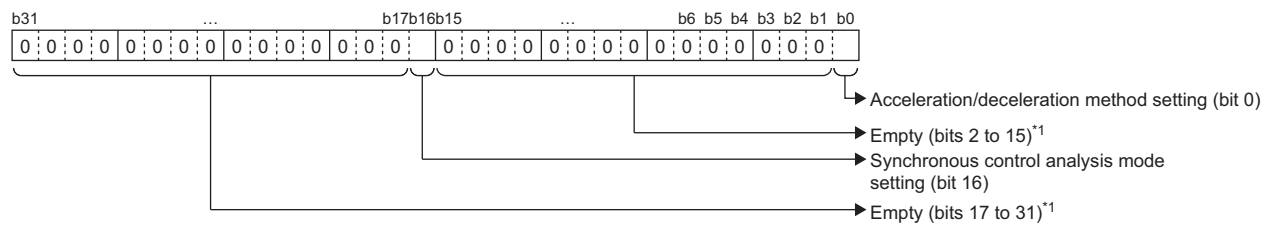
| Acceleration/deceleration method setting<br>(Options (Options): Bit 0 to 1) | Setting range                                                                           |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method<br>(mcAccDec)             | 0.0000 <sup>*1</sup> , positive numbers from 0.0001 to 2147483647.0 [U/s <sup>2</sup> ] |

<sup>\*1</sup> The operation performed at start varies depending on the setting of Operation selection at start acceleration/deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). When changing the acceleration or deceleration, the changes are not accepted.

## ■Options (Options)

The function options for this FB are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



<sup>\*1</sup> Set empty areas to "0".

| Bit | Name                                      | Description                                                                                                                          |
|-----|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| 0   | Acceleration/deceleration method setting  | Sets the acceleration/deceleration method used to perform control.<br>• 0: Acceleration/deceleration specification method (mcAccDec) |
| 16  | Synchronous control analysis mode setting | The synchronous control analysis mode is set.<br>• 0: Invalid<br>• 1: Valid                                                          |

• Acceleration/deceleration method setting (bit 0 to 1)

| Setting value                                                | Description                                                                          |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec) | An acceleration/deceleration method using Deceleration (Deceleration) set in this FB |

## Precautions

- Even if a stop cause occurs in an axis set to the input axis information of Master axis (Master), Auxiliary axis (AdvOutputName.Pr.AuxAxis), or Sub-input axis (AdvOutputName.Pr.SubAxis) while this FB is being executed, Slave axis (Slave) maintains control under the command transmitted from the input axis. The axis status of Slave axis (Slave) does not change. Also, even if a stop cause occurs in an axis set to Axis information (AdvOutputName.Axis) of the output axis, the axis set to Axis information (AdvInputName.Axis) of the input axis is not affected.
- When this FB is started, Master axis and slave axis cyclic reference (error code: 1AADH) occurs in the following cases.

### Error occurrence condition

When multiple axes are concatenated, Master axis (Master), Auxiliary axis (AdvOutputName.Pr.AuxAxis), and Sub-input axis (AdvOutputName.Pr.SubAxis) are set to Slave axis (Slave) of the single axis synchronous control FB in the later part.

257 or more single axis synchronous control FBs are concatenated.

- If Master axis (Master), Auxiliary axis (AdvOutputName.Pr.AuxAxis), or Sub-input axis (AdvOutputName.Pr.SubAxis) becomes serve OFF due to a servo alarm or emergency stop, Slave axis (Slave) may operate unexpectedly. Therefore, using MC\_Stop (Forced Stop) to stop the operation of this FB is recommended.
- When the input axis is operated before Axis status (AxisName.Md.AxisStatus) of Slave axis (Slave) being analyzed for starting this FB becomes "7: During synchronous operation (SynchronizedMotion)", the information on the input axis being analyzed, such as the movement amount and the amount of change due to changes in the current value or other factors, will be reflected immediately after the start of synchronous control. The output axis may suddenly accelerate depending on the amount of movement or change in the input axis. Therefore, start the operation of the input axis after checking that synchronous control is active.
- If the setting values of the member variables ADV\_INPUT and ADV\_OUTPUT, which are imported during synchronous control, are changed to values outside the range during the execution of this FB, Out of Parameter Range (Advanced synchronous control input axis) or Out of Parameter Range (Advanced synchronous control output axis) occurs, and the control continues with the setting value before the change.
- When the setting values of the member variables ADV\_INPUT and ADV\_OUTPUT are outside the range at the start of this FB, Out of Parameter Range (Advanced synchronous control input axis) or Out of Parameter Range (Advanced synchronous control output axis) occurs, and the operation will not start.
- When this FB is started, Operation cycle mismatch (error code: 1B29H) occurs in the following cases. Even when MCV\_SyncOperationCycles (Control operation cycle synchronization) is used, Operation cycle mismatch (error code: 1B29H) occurs if the following conditions are satisfied.

### Error occurrence condition

The control operation cycles of Master axis (Master), Auxiliary axis (AdvOutputName.Pr.AuxAxis), and Sub-input axis (AdvOutputName.Pr.SubAxis) do not match that of the Slave axis (Slave).

The control operation cycle of the output axis does not match the refresh cycle of the clutch signals.

## Program example

For a program example of this FB, refer to the following manual.

 User's manual for the controller used

# 46.24 Multiple Axes Positioning Data Operation

46

## MCv\_MovePositioningData

This FB operates the axes group according to the specified positioning data.



Before using this FB, check the versions of the controller and engineering tool.

User's manual for the controller used

| Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | FBD/LD                                                                                                                                                                                                                                                                       | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>MCv_MovePositioningData</p> <p>DUT: AxesGroup ——— AxesGroup :DUT</p> <p>DUT: PositioningData — PositioningData :DUT</p> <p>B: Execute Done :B</p> <p>UW: StartDataNo Busy :B</p> <p>ENUM: BufferMode Active :B</p> <p>UD: Options CommandAborted :B</p> <p>Error :B</p> <p>ErrorID :UW</p> <p>CurrentDataNo :UW</p> <p>PrereadingDataNo :UW</p> <p>RemainingLoopCount :UW</p> <p>InstanceID</p> <p>ResetMcode 0</p> <p>Mstrobe 0</p> <p>ValidMcode 0</p> <p>StepMode 0</p> <p>CurrentProfileNo 0</p> | <p>MCv_MovePositioningData</p> <p>Execute Done</p> <p>BufferMode Busy</p> <p>StartDataNo Active</p> <p>Options CommandAborted</p> <p>Error</p> <p>ErrorID</p> <p>CurrentDataNo</p> <p>PrereadingDataNo</p> <p>RemainingLoopCount</p> <p>AxesGroup</p> <p>PositioningData</p> | <pre> MCv_MovePositioningData(   AxesGroup:= ?AXES_GROUP_REF? ,   PositioningData:=     ?MC_POSITIONING_DATA_ID? ,   Execute:= ?BOOL? ,   StartDataNo:= ?WORD? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   CurrentDataNo=&gt; ?WORD? ,   PrereadingDataNo=&gt; ?WORD? ,   RemainingLoopCount=&gt; ?WORD? ); </pre> |

## Setting data

### I/O variables

| I/O variable    | Name                   | Data type              | Input    | Valid range | Default value         | Description                                                                                                                                                                                                                                            |
|-----------------|------------------------|------------------------|----------|-------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AxesGroup       | Axes group information | AXES_GROUP_REF         | At start | —           | Omission not possible | An axes group is set.                                                                                                                                                                                                                                  |
| PositioningData | Positioning data       | MC_POSITIONING_DATA_ID | At start | —           | Omission not possible | The operation profile ID of the positioning data is set.<br>The operation profile ID is set with an MC_POSITIONING_DATA_ID structure. For details on the MC_POSITIONING_DATA_ID structure, refer to the following.<br>Page 1487 MC_POSITIONING_DATA_ID |

### Input variables

| Input variable | Name                          | Data type            | Input    | Valid range                                            | Default value | Description                                                                                                                                                       |
|----------------|-------------------------------|----------------------|----------|--------------------------------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute        | Execution command             | BOOL                 | At start | TRUE, FALSE                                            | FALSE         | This FB is executed when the value is TRUE.                                                                                                                       |
| StartDataNo    | Start positioning data number | WORD (UINT)          | At start | 0 to 5000                                              | 0             | The positioning data number from which to start is set.<br>When this FB is executed with "0" set, it starts from positioning data number 1.                       |
| BufferMode     | Buffer mode                   | INT (MC_BUFFER_MODE) | At start | 0, 1                                                   | 0             | The buffer mode is set.<br>• 0: Aborting (mcAborting)<br>• 1: Buffered (mcBuffered)<br>For details, refer to the following.<br>Page 1912 Buffer mode (BufferMode) |
| Options        | Options                       | DWORD(HEX)           | At start | Refer to the following.<br>Page 1912 Options (Options) | 00000000H     | The function options for this FB are set in the specified bit position.<br>For details, refer to the following.<br>Page 1912 Options (Options)                    |

## ■Output variables

| Output variable    | Name                              | Data type   | Default value | Description                                                                                                                                                                                                                                                                                      |
|--------------------|-----------------------------------|-------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done               | Execution completion              | BOOL        | FALSE         | This variable becomes TRUE when the target position is reached.                                                                                                                                                                                                                                  |
| Busy               | Executing                         | BOOL        | FALSE         | This variable becomes TRUE when this FB is executed.                                                                                                                                                                                                                                             |
| Active             | Controlling                       | BOOL        | FALSE         | This variable becomes TRUE when this FB is controlling the axis.                                                                                                                                                                                                                                 |
| CommandAborted     | Abortion of execution             | BOOL        | FALSE         | This variable becomes TRUE when execution of this FB is aborted.                                                                                                                                                                                                                                 |
| Error              | Error                             | BOOL        | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                 |
| ErrorID            | Error code                        | WORD(UINT)  | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                                    |
| CurrentDataNo      | Executing positioning data number | WORD (UINT) | 0             | Indicates the positioning data number currently being executed.<br>The value is updated when the positioning data number is switched.                                                                                                                                                            |
| PrereadingDataNo   | Pre-read positioning data number  | WORD (UINT) | 0             | The last of the pre-read positioning data numbers is stored.<br>Positioning data numbers will be pre-read from Executing positioning data number (CurrentDataNo) to Preread positioning data number (PrereadingDataNo).                                                                          |
| RemainingLoopCount | Number of remaining loops         | WORD (UINT) | 0             | The number of remaining repetitions when executing the positioning data whose control method is LOOP is stored.<br>The stored value decrements by one at the start of the loop.<br>If the stored value is "0", the loop is not performed with the positioning data whose control method is LEND. |

## ■Public variables

| Public variable  | Name                     | Data type             | Default value | Description                                                                                                                                                                                                                                                                                                               |
|------------------|--------------------------|-----------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InstanceID       | Instance ID              | INSTANCE_ID           | 0             | The instance ID is stored.<br>This variable is automatically set by the system when an instance is created.                                                                                                                                                                                                               |
| ResetMcode       | M code reset             | BOOL                  | FALSE         | When this variable is set to TRUE, the M code is reset.<br>M strobe (Mstrobe) becomes FALSE after the reset.                                                                                                                                                                                                              |
| Mstrobe          | M strobe                 | BOOL                  | FALSE         | This variable becomes TRUE when the M code output is valid.<br>This variable becomes TRUE at the M code output timing (Options (Options): Bit 16).<br>This variable becomes FALSE when M code reset (ResetMcode) is TRUE.                                                                                                 |
| ValidMcode       | Valid M code             | WORD (UINT)           | 0             | The valid M code (that is output in the latest status) is stored.<br>When the M code output for the positioning data is valid, the M code is updated to that of the positioning data number at the M code output timing (Options (Options): Bit 16).<br>*: The value is not reset when M code reset (ResetMcode) is TRUE. |
| StepMode         | Step mode                | INT<br>(MC_STEP_MODE) | 0             | The step mode is set.<br>• 0: Ignored (Ignored)<br>• 1: Deceleration Unit Step (StepPerDec)<br>• 2: Positioning Data Unit Step (StepPerPositioningData)<br>For details, refer to the following.<br> Page 1912 Step mode (StepMode)     |
| CurrentProfileNo | Executing profile number | WORD (UINT)           | 0             | The profile ID number currently being executed is stored.<br>For details, refer to the following.<br> Page 1913 Executing profile number (CurrentProfileNo)                                                                            |



- The following table shows the cycles at which public variables are imported or updated.

| Public variable  | Import/update cycle                                                   |
|------------------|-----------------------------------------------------------------------|
| InstanceID       | Execution cycle of a POU (Program Organization Unit) that calls an FB |
| ResetMcode       | Control cycle of an axes group structuring axis <sup>*1</sup>         |
| Mstrobe          |                                                                       |
| ValidMcode       |                                                                       |
| StepMode         |                                                                       |
| CurrentProfileNo | Execution cycle of a POU (Program Organization Unit) that calls an FB |

<sup>\*1</sup> The output variable may not always match the update timing. To adjust the update timing, call an FB from a program in the same cycle.

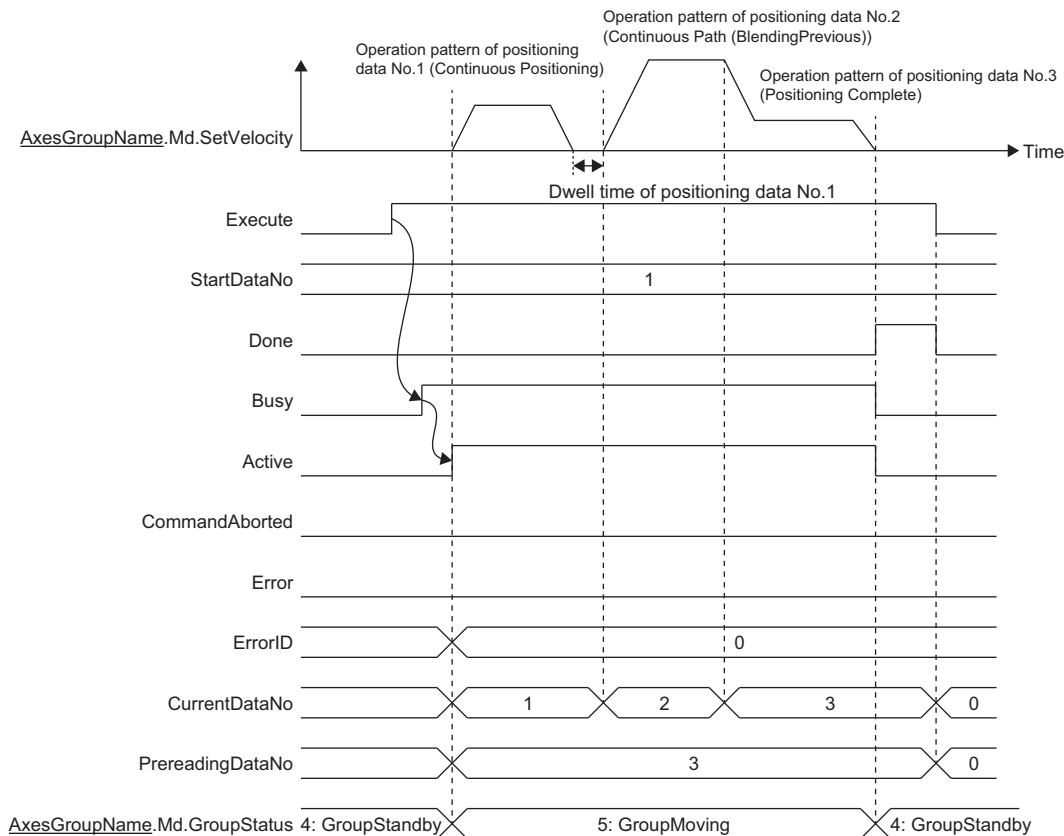
## Processing details

- The continuous positioning operation specified by the operation profile data (in the format of multiple axes positioning data) is performed on the axes group.
- In the multiple axes positioning data operation, the positioning data is read in ascending order starting from Start positioning data number (StartDataNo), and the multiple axes positioning operations are internally executed continuously.
- For details on the multiple axes positioning data operation, refer to the following.

📖 User's manual for the controller used

## ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

📖 Page 1435 Basic operation of Enable (Enable) type motion control FBs

## ■Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following table shows the buffer modes that can be set for this FB.

| Setting value            | Description                                                                                                                                                                                                                                       |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting) | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                       |
| 1: Buffered (mcBuffered) | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB. |

### Point

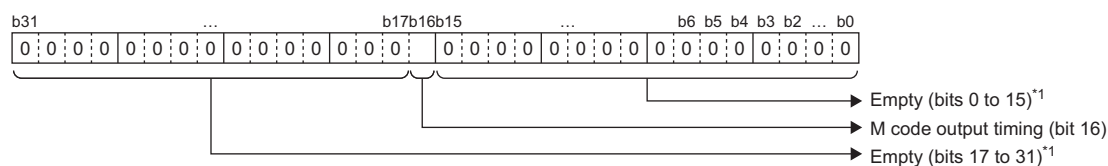
For details on multiple start (buffer mode), refer to the following.

📖 User's manual for the controller used

## ■Options (Options)

The function options for this FB are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than 0 is set, Out of options range (error code: 1ABBH) occurs.

| Bit | Name                 | Description                                                                       |
|-----|----------------------|-----------------------------------------------------------------------------------|
| 16  | M code output timing | The timing for outputting the M code is set.<br>• 0: WITH Mode<br>• 1: AFTER Mode |

• M code output timing (Bit 16)

| Setting value   | Description                                                                                                                                                                                                   |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: WITH Mode*2  | M strobe (Mstrobe) is set to TRUE when the positioning data starts positioning, and M code (Mcode) of the positioning data is stored in Valid M code (ValidMcode).                                            |
| 1: AFTER Mode*2 | M strobe (Mstrobe) is set to TRUE when the target position is reached (or after the setting time has elapsed when the dwell time is set), and the M code of the positioning data is stored in M code (Mcode). |

\*2 For details on each mode, refer to the following manual.

📖 User's manual for the controller used

## ■Step mode (StepMode)

The step mode is set.

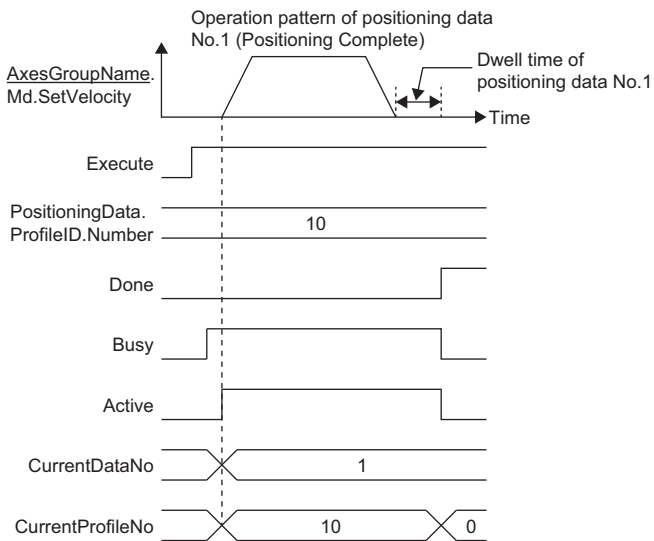
| Setting value                                          | Description                                                                                 |
|--------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 0: Ignored (Ignored)                                   | The step function is disabled.<br>The step mode is ignored.                                 |
| 1: Deceleration Unit Step (StepPerDec)                 | The step function is enabled.<br>The step operation is performed at each deceleration.      |
| 2: Positioning Data Unit Step (StepPerPositioningData) | The step function is enabled.<br>The step operation is performed for each positioning data. |

## ■Executing profile number (CurrentProfileNo)

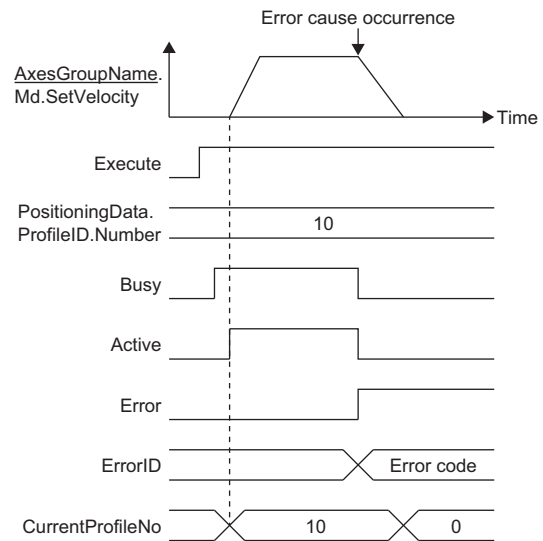
The profile ID number currently being executed is stored.

- This variable indicates that the operation profile data in the open area that is associated with the profile ID number is in use.
- The profile ID number is stored at the start of operation and cleared to 0 at the completion of the operation.

■When the FB is normal



■When an error occurred after the start of operation



- The stored value of Executing profile number (CurrentProfileNo) is not stored in Execution profile ID number (AxisName.Md.ProfileID) of the structuring axis in the axes group.

## ■Necessary object data

When using this FB, map the object assigned to the following object data for all structuring axes in the specified axes group to a PDO.

- Target position (607AH)

If a structuring axis that exists is the one without the object being mapped to PDO, Necessary object data unset (error code: 1AF7H) occurs and the operation will not start.

For details on object data settings, refer to the following manual.

📖 User's manual for the controller used

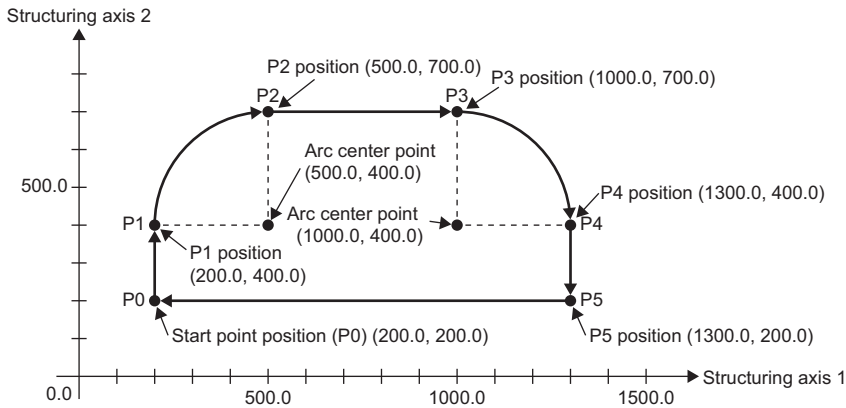
## Precautions

- In this FB, the start and multiple start (Aborting) operations may be delayed due to pre-reading and the operation profile data analysis on external signal settings and other items.

## Program example

This section provides examples of positioning control on Axes group 1 (AxesGroup001).

### • Operation



| Positioning data number | Path  | Positioning operation                                                                                                         |
|-------------------------|-------|-------------------------------------------------------------------------------------------------------------------------------|
| 1                       | P0→P1 | Positioning with Absolute Value Linear Interpolation (LinearAbsolute) from the start point position (P0) to the position (P1) |
| 2                       | P1→P2 | Positioning with Absolute Value Circular Interpolation (CircularAbsolute) from the position (P1) to the position (P2)         |
| 3                       | P2→P3 | Positioning with Absolute Value Linear Interpolation (LinearAbsolute) from the position (P2) to the position (P3)             |
| 4                       | P3→P4 | Positioning with Relative Value Circular Interpolation (CircularRelative) from the position (P3) to the position (P4)         |
| 5                       | P4→P5 | Positioning with Relative Value Linear Interpolation (LinearRelative) from the position (P4) to the position (P5)             |
| 6                       | P5→P0 | Positioning with Absolute Value Linear Interpolation (LinearAbsolute) from the position (P5) to the end point position (P0)   |

### • Axes group

| Item                  | Setting value |
|-----------------------|---------------|
| Configuration axis[1] | Axis0001      |
| Configuration axis[2] | Axis0002      |

## ■Axis

| Axis No. | Label name | Data type | Comment |
|----------|------------|-----------|---------|
| 1        | Axis0001*1 | AXIS_REF  | Axis 1  |
| 2        | Axis0002*1 | AXIS_REF  | Axis 2  |

\*1 To perform circular interpolation control, set Software stroke limit target (AxisName.Pr.SwStrokeLimit\_Target) of an axis parameter to valid (a value other than "-1: Invalid (Invalid)"). (In the program example, "1: Set position (SetPosition)" is set.)

## ■Axes group

| Axes group No. | Label name   | Data type      | Comment      |
|----------------|--------------|----------------|--------------|
| 1              | AxesGroup001 | AXES_GROUP_REF | Axes group 1 |

## ■ Operation profile data

| Profile ID | Label name          | Data type               | Comment                          |
|------------|---------------------|-------------------------|----------------------------------|
| 1          | PositioningData0001 | MC_POSITIONING_DATA_REF | Multiple axes positioning data 1 |

### • Operation profile data (PositioningData0001 (Multiple axes positioning data)) settings

| Item                                                        |                         | Positioning data number                                  |                                             |                                        |                                             |                                                          |                                                      |
|-------------------------------------------------------------|-------------------------|----------------------------------------------------------|---------------------------------------------|----------------------------------------|---------------------------------------------|----------------------------------------------------------|------------------------------------------------------|
|                                                             |                         | 1                                                        | 2                                           | 3                                      | 4                                           | 5                                                        | 6                                                    |
| Operation pattern                                           |                         | Continuous Path<br>(BlendingPrevious)                    | Continuous Path<br>(BlendingPrevious)       | Continuous Path<br>(BlendingPrevious)  | Continuous Path<br>(BlendingPrevious)       | Continuous<br>Positioning<br>(ContinuousPosit<br>ioning) | Positioning<br>Complete<br>(PositioningCompl<br>ete) |
| Control method                                              |                         | Absolute Value<br>Linear<br>Interpolation                | Absolute Value<br>Circular<br>Interpolation | Absolute Value<br>Linear Interpolation | Relative Value<br>Circular<br>Interpolation | Relative Value<br>Linear<br>Interpolation                | Absolute Value<br>Linear Interpolation               |
| Interpolation<br>axes                                       | Interpolation<br>axis 1 | Axis0001                                                 | Axis0001                                    | Axis0001                               | Axis0001                                    | Axis0001                                                 | Axis0001                                             |
|                                                             | Interpolation<br>axis 2 | Axis0002                                                 | Axis0002                                    | Axis0002                               | Axis0002                                    | Axis0002                                                 | Axis0002                                             |
| Circular interpolation mode                                 |                         | —                                                        | Center point<br>specification               | —                                      | Center point<br>specification               | —                                                        | —                                                    |
| Path selection                                              |                         | —                                                        | CW                                          | —                                      | CW                                          | —                                                        | —                                                    |
| Target<br>position/<br>movement<br>amount/end<br>point      | Interpolation<br>axis 1 | 200.0                                                    | 500.0                                       | 1000.0                                 | 300.0                                       | 0.0                                                      | 200.0                                                |
|                                                             | Interpolation<br>axis 2 | 400.0                                                    | 700.0                                       | 700.0                                  | -300.0                                      | -200.0                                                   | 200.0                                                |
| Direction<br>selection                                      | Interpolation<br>axis 1 | Positive direction                                       | —                                           | Positive direction                     | —                                           | —                                                        | Positive direction                                   |
|                                                             | Interpolation<br>axis 2 | Positive direction                                       | —                                           | Positive direction                     | —                                           | —                                                        | Positive direction                                   |
| Border point/<br>center point/<br>radius                    | Interpolation<br>axis 1 | —                                                        | 500.0                                       | —                                      | 0.0                                         | —                                                        | —                                                    |
|                                                             | Interpolation<br>axis 2 | —                                                        | 400.0                                       | —                                      | -300.0                                      | —                                                        | —                                                    |
| Speed mode                                                  |                         | Vector speed<br>specification                            | —                                           | Vector speed<br>specification          | —                                           | Vector speed<br>specification                            | Vector speed<br>specification                        |
| Velocity                                                    |                         | 100.0                                                    | 150.0                                       | 100.0                                  | 150.0                                       | 100.0                                                    | 100.0                                                |
| Acceleration/deceleration<br>method                         |                         | Acceleration/<br>deceleration<br>specification<br>method | —                                           | —                                      | —                                           | —                                                        | —                                                    |
| Acceleration/deceleration<br>time                           |                         | 400.0                                                    | 0.0                                         | 0.0                                    | 0.0                                         | 0.0                                                      | 0.0                                                  |
| Deceleration                                                |                         | 500.0                                                    | 0.0                                         | 0.0                                    | 0.0                                         | 0.0                                                      | 0.0                                                  |
| Jerk                                                        |                         | 500.0                                                    | 0.0                                         | 0.0                                    | 0.0                                         | 0.0                                                      | 0.0                                                  |
| Circular interpolation error<br>tolerance                   |                         | —                                                        | —                                           | —                                      | —                                           | —                                                        | —                                                    |
| Target position specification<br>exceeding the ring counter |                         | Disabled                                                 | —                                           | Disabled                               | —                                           | —                                                        | Disabled                                             |
| Dwell time                                                  |                         | 500.0                                                    | 0.0                                         | 0.0                                    | 0.0                                         | 0.3                                                      | 0.0                                                  |
| M code                                                      |                         | 0                                                        | 0                                           | 0                                      | 0                                           | 0                                                        | 0                                                    |
| M code output timing<br>override                            |                         | —                                                        | —                                           | —                                      | —                                           | —                                                        | —                                                    |

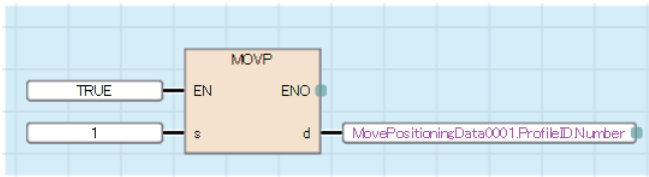
## ■Labels used

| Label name                            | Data type                            | Comment                                        |
|---------------------------------------|--------------------------------------|------------------------------------------------|
| MCv_MovePositioningData_1             | MCv_MovePositioningData              | Multiple axes positioning data operation FB    |
| bMovePosDataDone                      | Bit                                  | Execution completion                           |
| bMovePosDataBusy                      | Bit                                  | Executing                                      |
| bMovePosDataActive                    | Bit                                  | Controlling                                    |
| bMovePosDataCommandAborted            | Bit                                  | Abortion of execution                          |
| bMovePosDataError                     | Bit                                  | Error                                          |
| uwMovePosDataErrorID                  | Word [unsigned]/bit string [16 bits] | Error code                                     |
| uwMovePosDataCurrentDataNo            | Word [unsigned]/bit string [16 bits] | Executing positioning data number              |
| uwMovePosDataPrereadingDataNo         | Word [unsigned]/bit string [16 bits] | Pre-read positioning data number               |
| uwMovePosDataRemainingLoopCount       | Word [unsigned]/bit string [16 bits] | Number of remaining loops                      |
| MC_GroupEnable_1                      | MC_GroupEnable                       | Axes Group Enabled FB                          |
| bMovePositioningDataCMD               | Bit                                  | Multiple axes positioning data operation start |
| bGroupEnableDone                      | Bit                                  | Axes Group Enabled Completion                  |
| bGroupEnableBusy                      | Bit                                  | Executing                                      |
| bGroupEnableError                     | Bit                                  | Error                                          |
| uwGroupEnableErrorID                  | Word [unsigned]/bit string [16-bit]  | Error code                                     |
| MC_GroupDisable_1                     | MC_GroupDisable                      | Axes Group Disabled FB                         |
| bGroupDisableDone                     | Bit                                  | Axes Group Disabled Completion                 |
| bGroupDisableBusy                     | Bit                                  | Executing                                      |
| bGroupDisableError                    | Bit                                  | Error                                          |
| uwGroupDisableErrorID                 | Word [unsigned]/bit string [16-bit]  | Error code                                     |
| MovePositioningData0001 <sup>*1</sup> | MC_POSITIONING_DATA_ID               | Multiple axes positioning data 0001            |

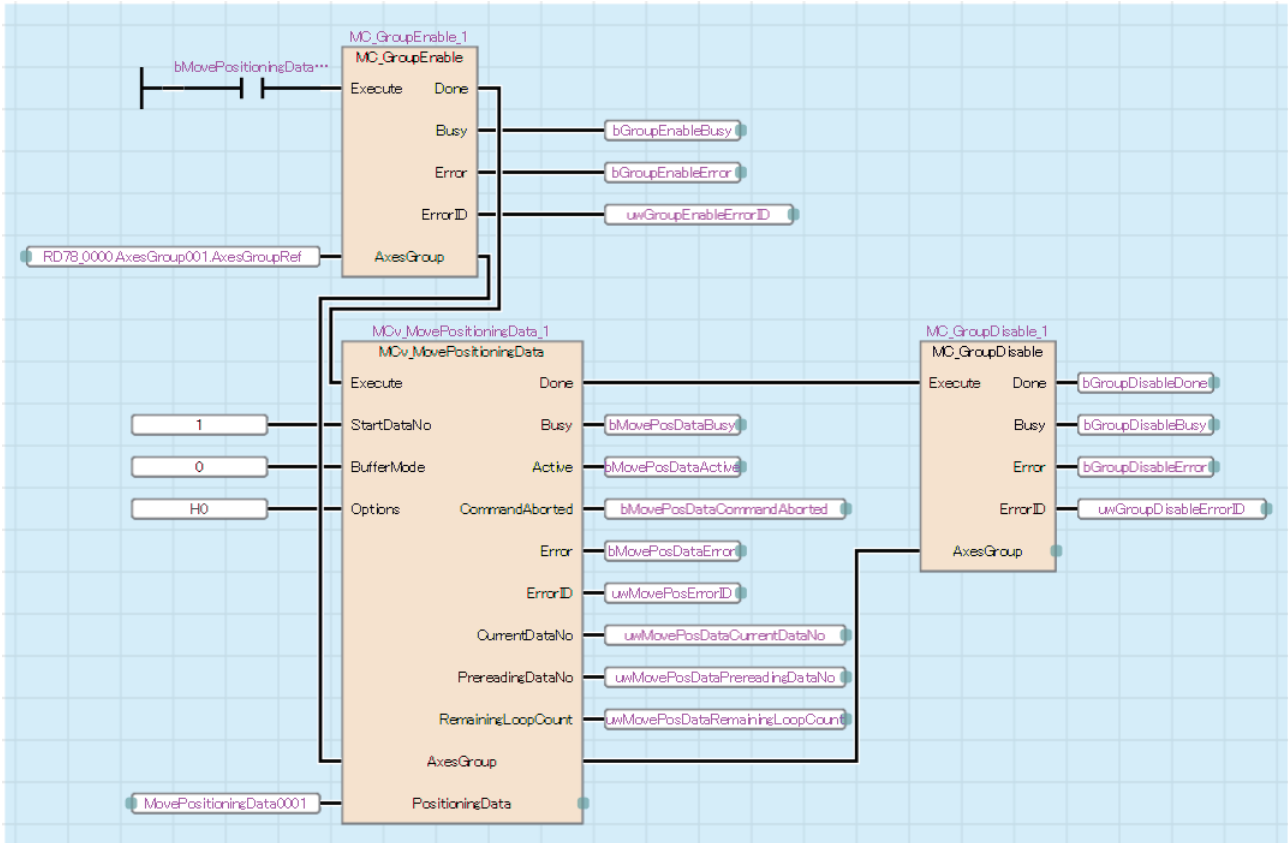
\*1 Only used in FBD/LD programs. (Required to use the operation profile data in FBD/LD programs.)

## ■FBD/LD program

- Data setting for 2-axis linear interpolation control



- Axes Group Enabled/Multiple Axes Positioning Data Operation/Axes Group Disabled



## ■ST program

//-----Axes group enabled-----

```
MC_GroupEnable_1(  
  AxesGroup:= AxesGroup001.AxesGroupRef ,  
  Execute:= bMovePositioningDataCMD ,  
  Done=> bGroupEnableDone,  
  Busy=> bGroupEnableBusy ,  
  Error=> bGroupEnableError ,  
  ErrorID=> uwGroupEnableErrorID  
);
```

//-----Multiple axes positioning data operation-----

```
MCv_MovePositioningData_1(  
  AxesGroup:= AxesGroup001.AxesGroupRef ,  
  PositioningData:= PositioningData0001.PositioningData ,  
  Execute:= bGroupEnableDone ,  
  StartDataNo:= 1 ,  
  BufferMode:= MC_BUFFER_MODE__mcAborting ,  
  Options:= H00000000 ,  
  Done=> bMovePosDataDone ,  
  Busy=> bMovePosDataBusy ,  
  Active=> bMovePosDataActive ,  
  CommandAborted=> bMovePosDataCommandAborted ,  
  Error=> bMovePosDataError ,  
  ErrorID=> uwMovePosDataErrorID ,  
  CurrentDataNo=> uwMovePosDataCurrentDataNo ,  
  PrereadingDataNo=> uwMovePosDataPrereadingDataNo ,  
  RemainingLoopCount=> uwMovePosDataRemainingLoopCount  
);
```

//-----Axes group disabled-----

```
MC_GroupDisable_1(  
  AxesGroup:= AxesGroup001.AxesGroupRef ,  
  Execute:= bMovePosDataDone ,  
  Done=> bGroupDisableDone ,  
  Busy=> bGroupDisableBusy ,  
  Error=> bGroupDisableError ,  
  ErrorID=> uwGroupDisableErrorID  
);
```



# 46.25 Absolute Position Tracking Control

46

## MCv\_PositionControl

This FB moves the specified axis to the target position according to the limit velocity, acceleration, deceleration, and jerk. In addition, even after the command has reached the target position, the axis can be moved by changing the target position with retrigger or continuous update.



Before using this FB, check the versions of the controller and engineering tool.

User's manual for the controller used

| Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                   | FBD/LD                                                                                                                                                                                                                                                                                                                                                       | ST                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The ladder diagram shows a single network with a callout box for the MCv_PositionControl function block. The inputs are: DUT: Axis, B: Execute, B: ContinuousUpdate, L: Position, L: Velocity, L: Acceleration, L: Deceleration, L: Jerk, ENUM: Direction, ENUM: BufferMode, and UD: Options. The outputs are: Axis :DUT, InAddress :B, Busy :B, Active :B, CommandAborted :B, Error :B, and ErrorID :UW.</p> | <p>The FBD/LD diagram shows a callout box for the MCv_PositionControl function block. The inputs are: Execute, ContinuousUpdate, Position, Velocity, Acceleration, Deceleration, Jerk, Direction, BufferMode, and Options. The outputs are: InAddress, Busy, Active, CommandAborted, Error, and ErrorID. The block is labeled with 'Axis' at the bottom.</p> | <pre> MCv_PositionControl(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   Position:= ?LREAL? ,   Velocity:= ?LREAL? ,   Acceleration:= ?LREAL? ,   Deceleration:= ?LREAL? ,   Jerk:= ?LREAL? ,   Direction:= ?INT? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   InAddress=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

## Setting data

### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

### Input variable

| Input variable   | Name              | Data type | Input                                                          | Valid range                                                                                                                                                                                                                                                                                         | Default value | Description                                                                                                        |
|------------------|-------------------|-----------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------|
| Execute          | Execution command | BOOL      | At start                                                       | TRUE, FALSE                                                                                                                                                                                                                                                                                         | FALSE         | This FB is executed when the value is TRUE.                                                                        |
| ContinuousUpdate | Continuous update | BOOL      | At start                                                       | TRUE, FALSE                                                                                                                                                                                                                                                                                         | FALSE         | The target position, velocity, acceleration, and deceleration can be continuously changed while the value is TRUE. |
| Position         | Target position   | LREAL     | At start/<br>Retrigger possible/<br>Continuous update possible | <p>■When the ring counter is disabled<br/> <math>-10000000000.0 \leq \text{Target position} &lt; 10000000000.0</math></p> <p>■When the ring counter is enabled<br/>           Ring counter lower limit value <math>\leq</math> Target position <math>&lt;</math> Ring counter upper limit value</p> | 0.0           | The target position is set.<br>For details, refer to the following.<br>Page 1922 Target position (Position)        |

| Input variable | Name                  | Data type                 | Input                                                          | Valid range                    | Default value | Description                                                                                                                                                                                           |
|----------------|-----------------------|---------------------------|----------------------------------------------------------------|--------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Velocity       | Velocity              | LREAL                     | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0, 0.0001 to 2500000000.0    | 0.0           | The velocity is set.<br>For details, refer to the following.<br> Page 1924 Velocity (Velocity)                     |
| Acceleration   | Acceleration          | LREAL                     | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The acceleration is set.<br>For details, refer to the following.<br> Page 1924 Acceleration (Acceleration)         |
| Deceleration   | Deceleration          | LREAL                     | At start/<br>Retrigger possible/<br>Continuous update possible | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The deceleration is set.<br>For details, refer to the following.<br> Page 1924 Deceleration (Deceleration)         |
| Jerk           | Jerk                  | LREAL                     | At start                                                       | 0.0000, 0.0001 to 2147483647.0 | 0.0           | The jerk is set.<br>For details, refer to the following.<br> Page 1924 Jerk (Jerk)                                 |
| Direction      | Direction selection   | INT (MC_DIRECTION[0..15]) | At start/<br>Retrigger possible/<br>Continuous update possible | 1, 2, 3                        | 3             | The direction is set.<br>For details, refer to the following.<br> Page 1925 Direction selection (Direction)        |
| BufferMode     | Buffer mode selection | INT (MC_BUFFER_MODE)      | At start                                                       | 0, 1, 2, 3, 4, 5               | 0             | The buffer mode is set.<br>For details, refer to the following.<br> Page 1928 Buffer mode (BufferMode)             |
| Options        | Options               | DWORD(HEX)                | At start                                                       | 00000000H to 00070021H         | 00000000H     | The function options of this FB are set.<br>For details, refer to the following.<br> Page 1929 Options (Options) |

## ■Output variables

| Output variable | Name                    | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                         |
|-----------------|-------------------------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InAddress       | Target position reached | BOOL       | FALSE         | This variable becomes TRUE when Commanded position ( <u>AxisName</u> .Md.SetPosition) calculated by the motion system reaches the target position. When the target position has been changed when Continuous update (ContinuousUpdate) is valid (TRUE), this variable remains FALSE until the set position reaches the post-change target position. |
| Busy            | Executing               | BOOL       | FALSE         | This variable becomes TRUE when this FB is being executed.                                                                                                                                                                                                                                                                                          |
| Active          | Controlling             | BOOL       | FALSE         | This variable becomes TRUE when this FB is controlling the axis.                                                                                                                                                                                                                                                                                    |
| CommandAborted  | Abortion of execution   | BOOL       | FALSE         | This variable becomes TRUE when execution is aborted by another FB.<br>This variable becomes TRUE when this FB is stopped due to error occurrence or this FB is started during an error.<br>The variable becomes FALSE when Execution command (Execute) becomes FALSE.                                                                              |
| Error           | Error                   | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                    |
| ErrorID         | Error code              | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used                                                                                                   |

## Processing details

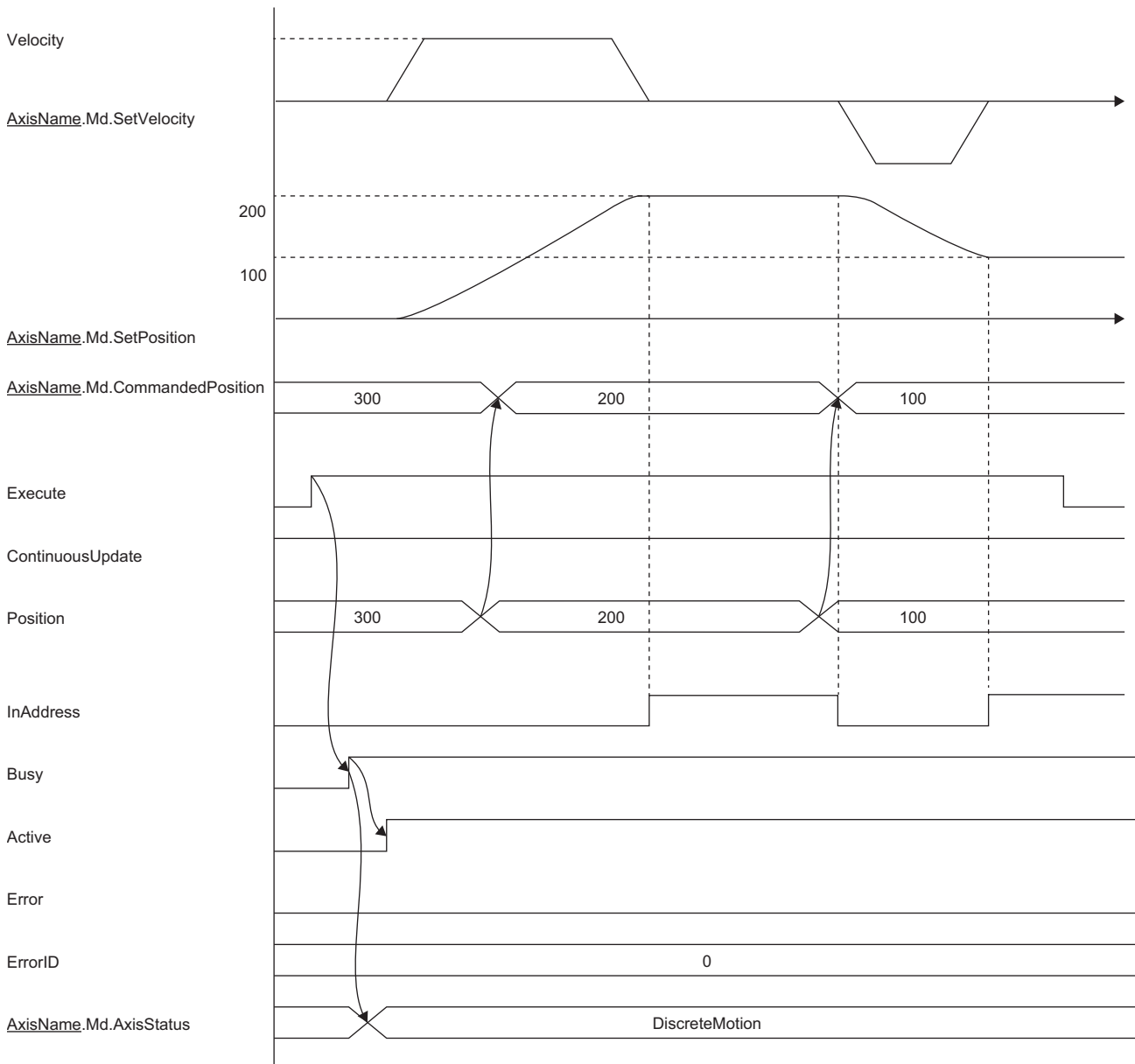
This FB moves the specified Axis (Axis) to Target position (Position) according to the limit velocity, Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). In addition, even after the command has reached the target position, the axis can be moved by changing Target position (Position) with retrigger or Continuous update (ContinuousUpdate).

When Target position (Position) is changed before the axis reaches Target position (Position), the axis moves to the target position after change.

Execution of this FB is completed when MC\_Stop (Forced Stop) or other motion FB is executed.

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

☞ Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■Target position (Position)

The target position of the absolute position is set according to the axis unit. When the setting value is negative, the axis moves in the negative direction. When 0 is set, the axis does not move, but Axis status (AxisName.Md.AxisStatus) of the target axis becomes "5: During positioning operation (DiscreteMotion)".

The following table summarizes the valid ranges. If a value outside the range is set, Out of target position range (error code: 1A85H) occurs and the axis will not start.

| Ring counter setting | Valid range                                                                              |
|----------------------|------------------------------------------------------------------------------------------|
| Invalid              | $-10000000000.0 \leq \text{Target position} < 10000000000.0$                             |
| Valid                | Ring counter lower limit value $\leq$ Target position $<$ Ring counter upper limit value |

When the software stroke limit is valid (when Software stroke limit target (AxisName.Md.SwStrokeLimit\_Target) is set to a value other than "-1: Invalid (Invalid)")

- Software stroke limit over (target position) (error code: 1A80H) occurs and the axis will not start if a position which exceeds the software stroke limit is specified as the target position.
- The Direction selection (Direction) setting is ignored and positioning control is performed in a direction which does not cross over into the area outside the software stroke limit range.
- When the value does not cross over into the area outside the software stroke limit range both in the positive direction and the negative direction, positioning control is performed in the direction closest to Target position (Position) (the direction in which the absolute value of the movement amount is shortest) based on the current position.
- When the distance is the same between the positive direction and negative direction, the moving direction of the motion control FB executed the last time or the moving direction when the target position was changed in the previous execution will be carried over for the operation. If the previous moving direction is not available, the axis will move in the positive direction.

When the software stroke limit is invalid (when Software stroke limit target (AxisName.Md.SwStrokeLimit\_Target) is set to "-1: Invalid (Invalid)"), positioning control is performed within the valid range.

The target position change will be ignored one operation cycle before Target position reached (InAddress) becomes TRUE.

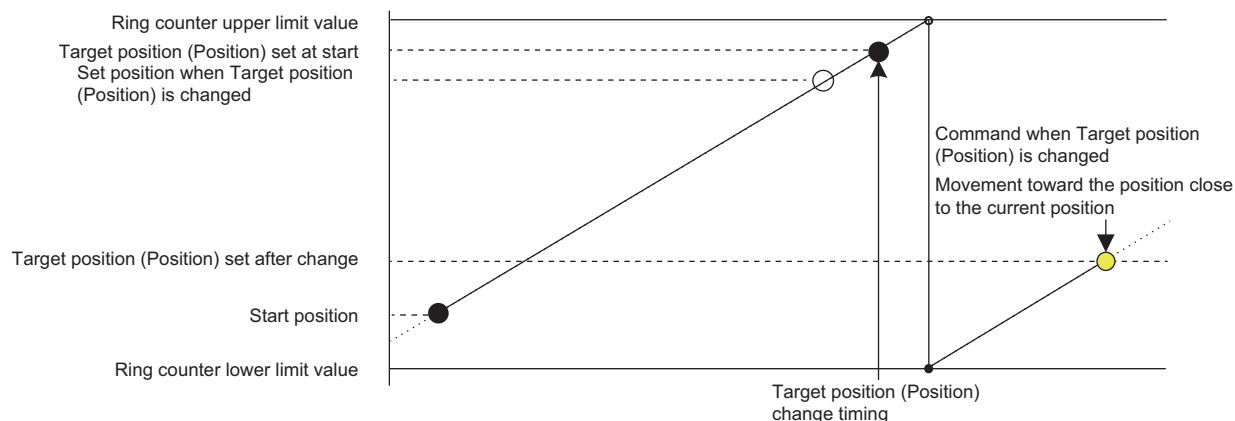
If Target position (Position) is changed, the changed operation varies depending on the Direction selection (Direction) setting.

- If a value outside the range is set for Target position (Position) during execution of the motion control FB, Out of Position/Distance setting range warning (event code: 00D0DH) occurs and the operation continues with the previous setting.
- When Out of Position/Distance setting range warning (event code: 00D0DH) occurs, if Direction selection (Direction) has been changed, the operation continues with the previous Direction selection (Direction) setting.
- When Out of direction selection range warning (event code: 00D4DH) occurs, the operation continues with the previous Target position (Position) setting.

### Ex.

When the shortest path is set, the axis moves from the set position at the time of the change in the direction closest to Target position (Position) after the change.

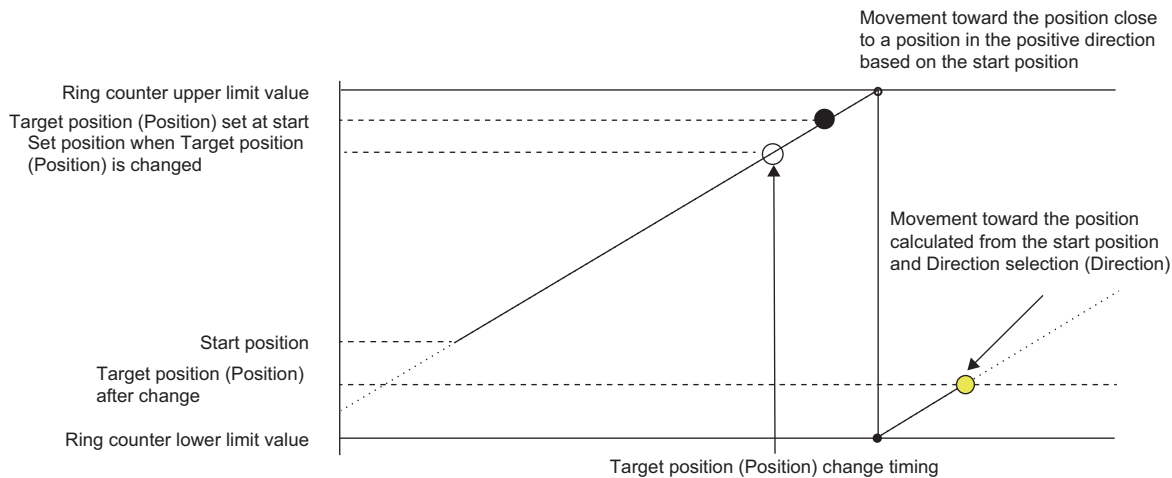
"Start" in the following refers to the start of the motion control FB after the first operation and the change of Target position (Position) after Target position reached (InAddress) becomes TRUE in the previous operation.



**Ex.**

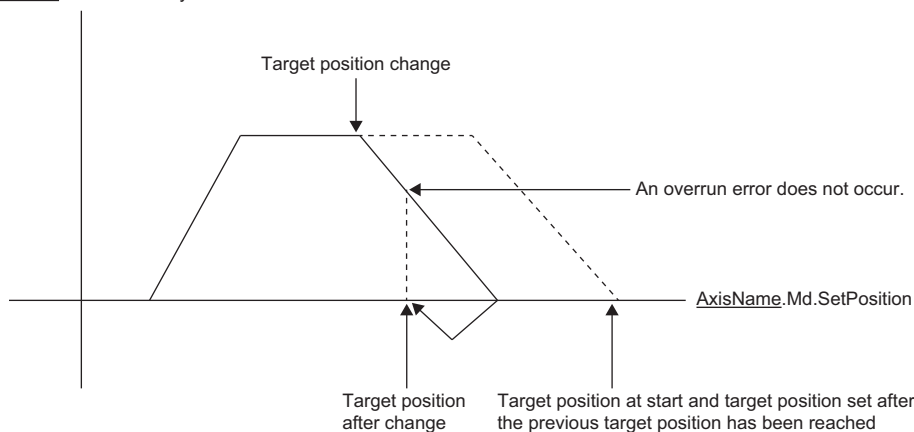
When a path other than the shortest path is set, Target position (Position) is calculated from the set position and Direction selection (Direction) at the time of change.

"Start" in the following refers to the start of the motion control FB after the first operation and the change of Target position (Position) after Target position reached (InAddress) becomes TRUE in the previous operation.



If the reverse operation is performed due to the change in Target position (Position), or if the axis has passed Target position (Position) after the change during the change, the axis decelerates to stop. After the deceleration stop is completed, the operation starts toward the changed Target position (Position). In that case, no overrun error will occur.

AxisName.Md.SetVelocity



## ■Velocity (Velocity)

The command velocity is set for this FB.

### Setting range

0.0, 0.0001 to 2500000000.0

When the setting is omitted or set as 0.0, the axis does not operate, but Axis status (AxisName.Md.AxisStatus) changes to "6: During continuous operation (ContinuousMotion)".

If a value outside the range is set, Out of velocity range (error code: 1ABAH) occurs and the axis will not start.

For details on the operation while the motion control FB is being executed, refer to the user's manual for the controller used.

## ■Acceleration (Acceleration)

The acceleration is set for this FB. For details on the acceleration/deceleration method, refer to the user's manual for the controller used.

If a value outside the range is set, Out of acceleration range (error code: 1A8DH) occurs and the axis will not start.

For details on the operation while the motion control FB is being executed, refer to the user's manual for the controller used.

## ■Deceleration (Deceleration)

The deceleration is set for this FB. For details on the acceleration/deceleration method, refer to the user's manual for the controller used.

If a value outside the range is set, Out of deceleration range (error code: 1A8EH) occurs and the axis will not start.

For details on the operation while the motion control FB is being executed, refer to the user's manual for the controller used.

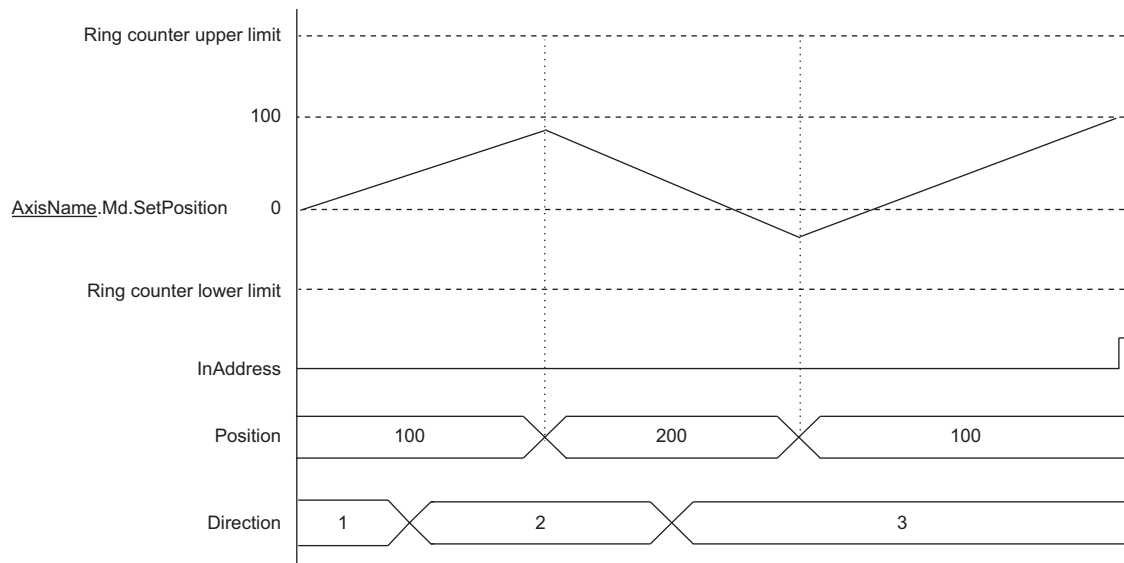
## ■Jerk (Jerk)

The jerk is set for this FB. For details on the acceleration/deceleration method, refer to the user's manual for the controller used.

If a value outside the range is set, Out of jerk range (error code: 1A8FH) occurs and the axis will not start.

## ■Direction selection (Direction)

The operation direction is specified. When continuous update or retrigger is performed, Direction selection (Direction) will not be reflected at the timing when the value is changed, but will be reflected when Target position (Position) is changed.



Choose one of the following:

- 1: Positive direction (mcPositiveDirection)
- 2: Negative direction (mcNegativeDirection)
- 3: Shortest path (mcShortestWay)

If a value outside the range is set for Direction selection (Direction) at start, Out of direction selection range (error code: 1AA5H) occurs and the axis will not start.

If a value outside the range is set for Direction selection (Direction) during control, Out of direction selection range warning (event code: 00D4DH) occurs and the operation continues with the previous setting. If Target position (Position) is changed at the same time as Direction selection (Direction), the operation continues with the previous Target position (Position) setting. The setting for Direction selection (Direction) is ignored when the software stroke limit is valid.

When the software stroke limit is invalid, the direction used to move from the current position to Target position (Position) can be set by selecting from "1: Positive direction (mcPositiveDirection)", "2: Negative direction (mcNegativeDirection)", or "3: Shortest path (mcShortestWay)" in Direction selection (Direction).

- 1: Positive direction (mcPositiveDirection)

Performs positioning from the current position to the target position in the positive direction (address increasing).

| Setting range                                                    | Operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Current value ≤ Target position < Ring counter upper limit value | <p>The graph shows a coordinate system with a vertical axis labeled 'Ring counter' and values -100.0, 0.0, and 100.0. The horizontal axis represents position. A dashed diagonal line represents the ring counter's periodic nature. A solid line shows the current value starting at 0.0 and moving upwards to a target position (marked with a circle) that is below the upper limit value of 100.0. An arrow indicates the direction of movement.</p>                                                                                           |
| Ring counter lower limit value ≤ Target position < Current value | <p>The graph shows a coordinate system with a vertical axis labeled 'Ring counter' and values -100.0, 0.0, and 100.0. The horizontal axis represents position. A dashed diagonal line represents the ring counter's periodic nature. A solid line shows the current value starting at 0.0 and moving upwards. It reaches the upper limit value of 100.0, wraps around to -100.0, and then continues to move upwards to a target position (marked with a circle) that is below the current value. An arrow indicates the direction of movement.</p> |

- 2: Negative direction (mcNegativeDirection)

Performs positioning in the negative direction (address decreasing) from the current position to the target position.

| Setting range                                                    | Operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ring counter lower limit value ≤ Target position ≤ Current value | <p>The graph shows a coordinate system with a vertical axis labeled 'Ring counter' and values -100.0, 0.0, and 100.0. The horizontal axis represents position. A dashed diagonal line represents the ring counter's periodic nature. A solid line shows the current value starting at 0.0 and moving downwards to a target position (marked with a circle) that is above the lower limit value of -100.0. An arrow indicates the direction of movement.</p>                                                                                            |
| Current value < Target position < Ring counter upper limit value | <p>The graph shows a coordinate system with a vertical axis labeled 'Ring counter' and values -100.0, 0.0, and 100.0. The horizontal axis represents position. A dashed diagonal line represents the ring counter's periodic nature. A solid line shows the current value starting at 0.0 and moving downwards. It reaches the lower limit value of -100.0, wraps around to 100.0, and then continues to move downwards to a target position (marked with a circle) that is above the current value. An arrow indicates the direction of movement.</p> |



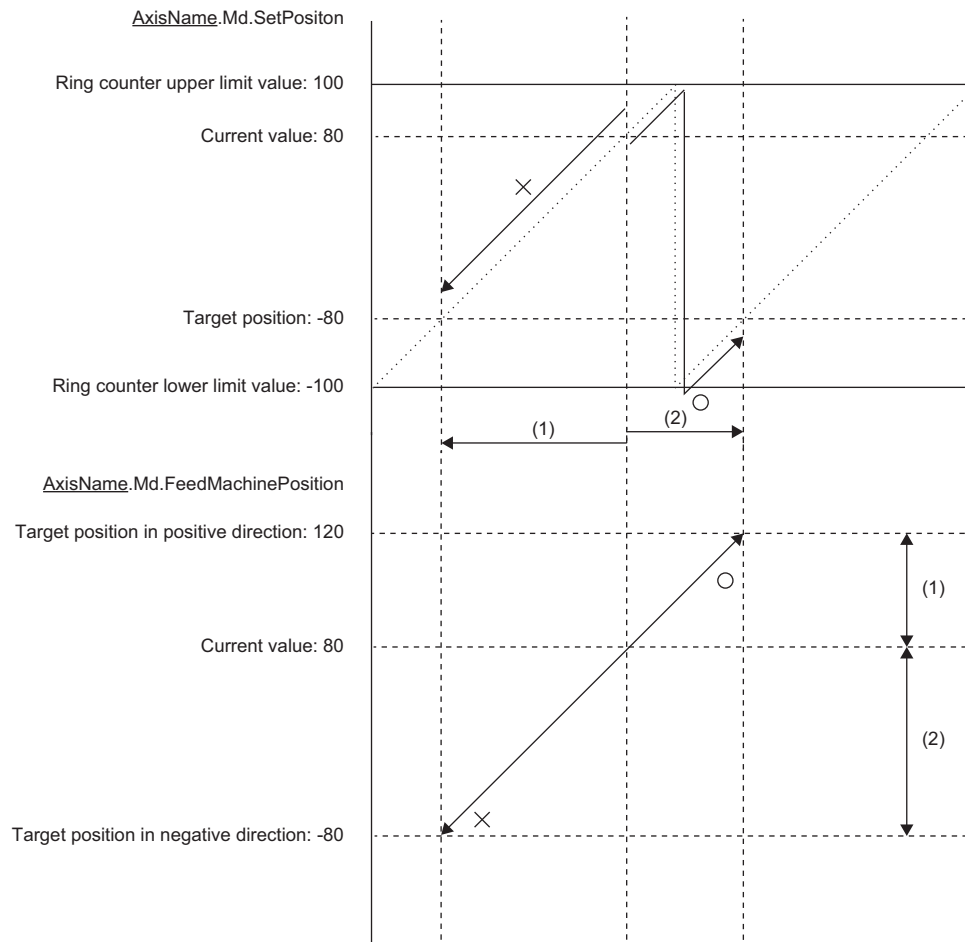
- 3: Shortest path (mcShortestWay)

Based on the current position, positioning control is performed in the direction closest to the target position (the direction in which the absolute value of the movement amount is shortest). If the distance is the same in both the positive direction and the negative direction, control is performed using the current direction. The setting range of the target position is "Ring counter lower limit value  $\leq$  Target position  $<$  Ring counter upper limit value". If a value outside the range is set, Out of target position range (error code: 1A85H) occurs and the axis will not start.

**Ex.**

Operation when set to the values shown below

- Ring counter upper limit value: 100.0
- Ring counter lower limit value: -100.0
- Current position: 80.0
- Target position: -80.0



Since the movement amount of (1) is "160.0" and the movement amount of (2) is "40.0", positioning moves in the positive direction from (2).

## ■ Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following table shows the buffer modes that can be set for this FB.

| Setting value                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Aborting (mcAborting)                 | Aborts (cancels) the under-control FB and executes the next FB immediately.                                                                                                                                                                                                                                                                                                                                                                          |
| 1: Buffered (mcBuffered)                 | Buffers the next FB on the under-control FB.<br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after completion of the under-control FB.                                                                                                                                                                                                    |
| 2: BlendingLow (mcBlendingLow)           | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the lower target velocity between the under-control FB and the buffering FB is used as the switching speed.  |
| 3: BlendingPrevious (mcBlendingPrevious) | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the under-control FB is used as the switching speed.                                  |
| 4: BlendingNext (mcBlendingNext)         | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the target velocity of the buffering FB is used as the switching speed.                                      |
| 5: BlendingHigh (mcBlendingHigh)         | Buffers the next FB on the under-control FB.* <sup>1</sup><br>If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.)<br>Buffering FBs are executed in order after the under-control FB reaches the target position.<br>When the under-control FB reaches the target position, the higher target velocity between the under-control FB and the buffering FB is used as the switching speed. |

\*<sup>1</sup> Stops are not performed between the under-control FB and the buffering FB.



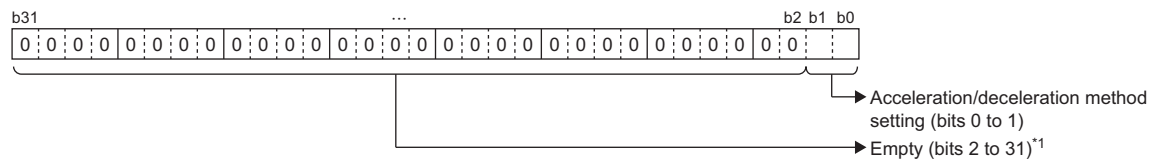
For details on multiple start (buffer mode), refer to the following.

User's manual for the controller used

## ■Options (Options)

The function options for this FB are set in the specified bit position.

The following figure shows how the settings should be configured with bit specification.



\*1 Set empty areas to "0". If a value other than "0" is set, Out of Options Range (error code: 1ABBH) occurs.

| Bit    | Name                                     | Description                                                                                                                                                                                                                                                 |
|--------|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 to 1 | Acceleration/deceleration method setting | Sets the acceleration/deceleration method used to perform control. <ul style="list-style-type: none"> <li>• 0: Acceleration/deceleration specification method (mcAccDec)</li> <li>• 1: Acceleration/deceleration time-fixed method (mcFixedTime)</li> </ul> |

### • Acceleration/deceleration method setting (bit 0 to 1)

| Setting value                                                | Description                                                                                                                                                                                                                                        |
|--------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Acceleration/deceleration specification method (mcAccDec) | An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) set in this FB                                                                                                                 |
| 1: Acceleration/deceleration time-fixed method (mcFixedTime) | An acceleration/deceleration method using the acceleration/deceleration time set in this FB regardless of the velocity. The acceleration/deceleration time does not use Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). |

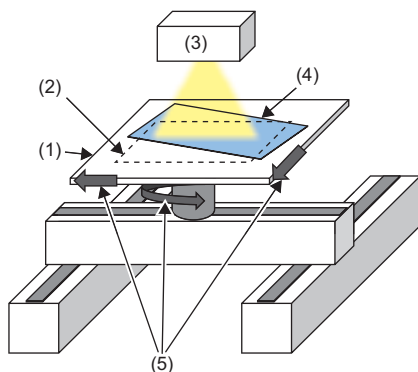
## Precautions

If Target position (Position) and Direction selection (Direction) are changed at the same time, data inconsistency may occur. By changing Direction selection (Direction) before changing Target position (Position), both changes can be applied when Target position (Position) is changed. If the values of Target position (Position) and Direction selection (Direction) need to be changed at the same time, execute this FB with the program execution cycle set to "Fixed Scan" or restart this FB.

## Program example

The following is a program example that uses this FB to move the workpiece on the XYθ table to the reference position based on the correction information (θ/X/Y axis correction values) from the sensor.

- Operation



- (1): XYθ table  
 (2): Reference position  
 (3): Sensor  
 (4): Workpiece  
 (5): The position is corrected by following the position based on the correction information from the sensor.

### ■Axes

| Setting item          | X axis          | Y axis          | θ axis          |
|-----------------------|-----------------|-----------------|-----------------|
| Axis type             | Real drive axis | Real drive axis | Real drive axis |
| Position command unit | μm              | μm              | degree          |

### ■Labels used

| Label name                   | Data type                    | Comment                                                                       |
|------------------------------|------------------------------|-------------------------------------------------------------------------------|
| bMCv_PositionControl_Execute | Bit                          | Control start                                                                 |
| leMCv_PositionControl_Pos_1  | Double-precision real number | Input to MCv_PositionControl_1.Position                                       |
| leMCv_PositionControl_Pos_2  | Double-precision real number | Input to MCv_PositionControl_2.Position                                       |
| leMCv_PositionControl_Pos_3  | Double-precision real number | Input to MCv_PositionControl_3.Position                                       |
| leCorrectionValue_Theta      | Double-precision real number | θ-axis correction value (input the correction value obtained from the sensor) |
| leCorrectionValue_XPos       | Double-precision real number | X-axis correction value (input the correction value obtained from the sensor) |
| leCorrectionValue_YPos       | Double-precision real number | Y-axis correction value (input the correction value obtained from the sensor) |

## ■ST program

```
//Input the correction value from the sensor
leMCv_PositionControl_Pos_1:= leCorrectionValue_Theta;
leMCv_PositionControl_Pos_2:= leCorrectionValue_XPos;
leMCv_PositionControl_Pos_3:= leCorrectionValue_YPos;
```

```
//-----Axis 1: Absolute position follow-up control-----
```

```
MCv_PositionControl_1 (
  Axis:= Axis0001.AxisRef ,
  Execute:= bMCv_PositionControl_Execute,
  ContinuousUpdate:= TRUE ,
  Position:= leMCv_PositionControl_Pos_1
  Velocity:= 100000.0 ,
  Acceleration:= 1000.0 ,
  Deceleration:= 1000.0 ,
  Jerk:= 0.0 ,
  Direction:= MC_DIRECTION__mcPositiveDirection ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= 0
);
```

```
//-----Axis 2: Absolute position follow-up control-----
```

```
MCv_PositionControl_2 (
  Axis:= Axis0002.AxisRef ,
  Execute:= bMCv_PositionControl_Execute,
  ContinuousUpdate:= TRUE ,
  Position:= leMCv_PositionControl_Pos_2
  Velocity:= 10000000.0 ,
  Acceleration:= 100000.0 ,
  Deceleration:= 100000.0 ,
  Jerk:= 0.0 ,
  Direction:= MC_DIRECTION__mcPositiveDirection ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= 0
);
```

```
//-----Axis 3: Absolute position follow-up control-----
```

```
MCv_PositionControl_3 (
  Axis:= Axis0003.AxisRef ,
  Execute:= bMCv_PositionControl_Execute,
  ContinuousUpdate:= TRUE ,
  Position:= leMCv_PositionControl_Pos_3
  Velocity:= 10000000.0 ,
  Acceleration:= 100000.0 ,
  Deceleration:= 100000.0 ,
  Jerk:= 0.0 ,
  Direction:= MC_DIRECTION__mcPositiveDirection ,
  BufferMode:= MC_BUFFER_MODE__mcAborting ,
  Options:= 0
);
```

# 46.26 Motion Cyclic Position Control

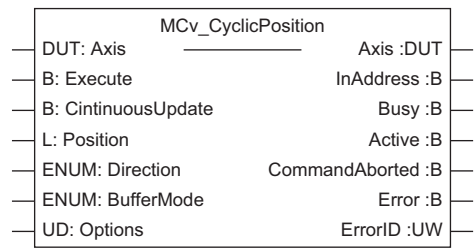
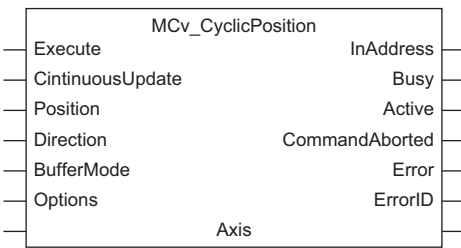
## MCv\_CyclicPosition

This FB sends the target position to a drive unit according to the specified target position.

### Restriction

Before using this FB, check the versions of the controller and engineering tool.

 User's manual for the controller used

| Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | FBD/LD                                                                                                                                                                                                                                                                                                                                                                                                             | ST                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>MCv_CyclicPosition</p> <p>DUT: Axis                      Axis :DUT</p> <p>B: Execute                      InAddress :B</p> <p>B: ContinuousUpdate                      Busy :B</p> <p>L: Position                      Active :B</p> <p>ENUM: Direction                      CommandAborted :B</p> <p>ENUM: BufferMode                      Error :B</p> <p>UD: Options                      ErrorID :UW</p> |  <p>MCv_CyclicPosition</p> <p>Execute                      InAddress</p> <p>ContinuousUpdate                      Busy</p> <p>Position                      Active</p> <p>Direction                      CommandAborted</p> <p>BufferMode                      Error</p> <p>Options                      ErrorID</p> <p>Axis</p> | <pre> MCv_CyclicPosition(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   Position:= ?LREAL? ,   Direction:= ?INT? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   InAddress=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                                                                                                          |
|--------------|------------------|-----------|----------|-------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br> Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

## Input variable

| Input variable    | Name                | Data type      | Input                                                          | Valid range                                                                                                                                                                                                                                                                                | Default value | Description                                                                                                                                                                                                                                                                                                    |
|-------------------|---------------------|----------------|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute           | Execution command   | BOOL           | At start                                                       | —                                                                                                                                                                                                                                                                                          | FALSE         | This FB is executed when the value is TRUE.                                                                                                                                                                                                                                                                    |
| Continuous Update | Continuous update   | BOOL           | At start                                                       | —                                                                                                                                                                                                                                                                                          | FALSE         | The target position can be continuously changed while the value is TRUE.                                                                                                                                                                                                                                       |
| Position          | Target position     | LREAL          | At start/<br>Retrigger possible/<br>Continuous update possible | <p>■When the ring counter is invalid<br/> <math>-10000000000.0 \leq \text{Setting value} &lt; 10000000000.0</math></p> <p>■When the ring counter is valid<br/> <math>\text{Ring counter lower limit value} \leq \text{Setting value} &lt; \text{Ring counter upper limit value}</math></p> | 0             | The target position of the absolute position is set in the positioning range.<br>For details, refer to the following.<br> Page 1936 Target position (Position)                                                              |
| Direction         | Direction selection | MC_DIRECTION   | At start/<br>Retrigger possible/<br>Continuous update possible | 1, 2, 3                                                                                                                                                                                                                                                                                    | 0             | When the software stroke limit is disabled, the direction used to move from the current position to the target position is specified.<br>For details, refer to the following.<br> Page 1937 Direction selection (Direction) |
| BufferMode        | Buffer mode         | MC_BUFFER_MODE | At start                                                       | mcAborting                                                                                                                                                                                                                                                                                 | mcAborting    | The buffer mode is set.<br>For details, refer to the following.<br> Page 1940 Buffer mode (BufferMode)                                                                                                                      |
| Options           | Options             | DWORD(HEX)     | At start                                                       | Fixed to 0                                                                                                                                                                                                                                                                                 | 0             | This variable cannot be set for this FB. Set 0. If a value other than 0 is set, Out of options range (error code: 1ABBH) occurs.                                                                                                                                                                               |

## Output variables

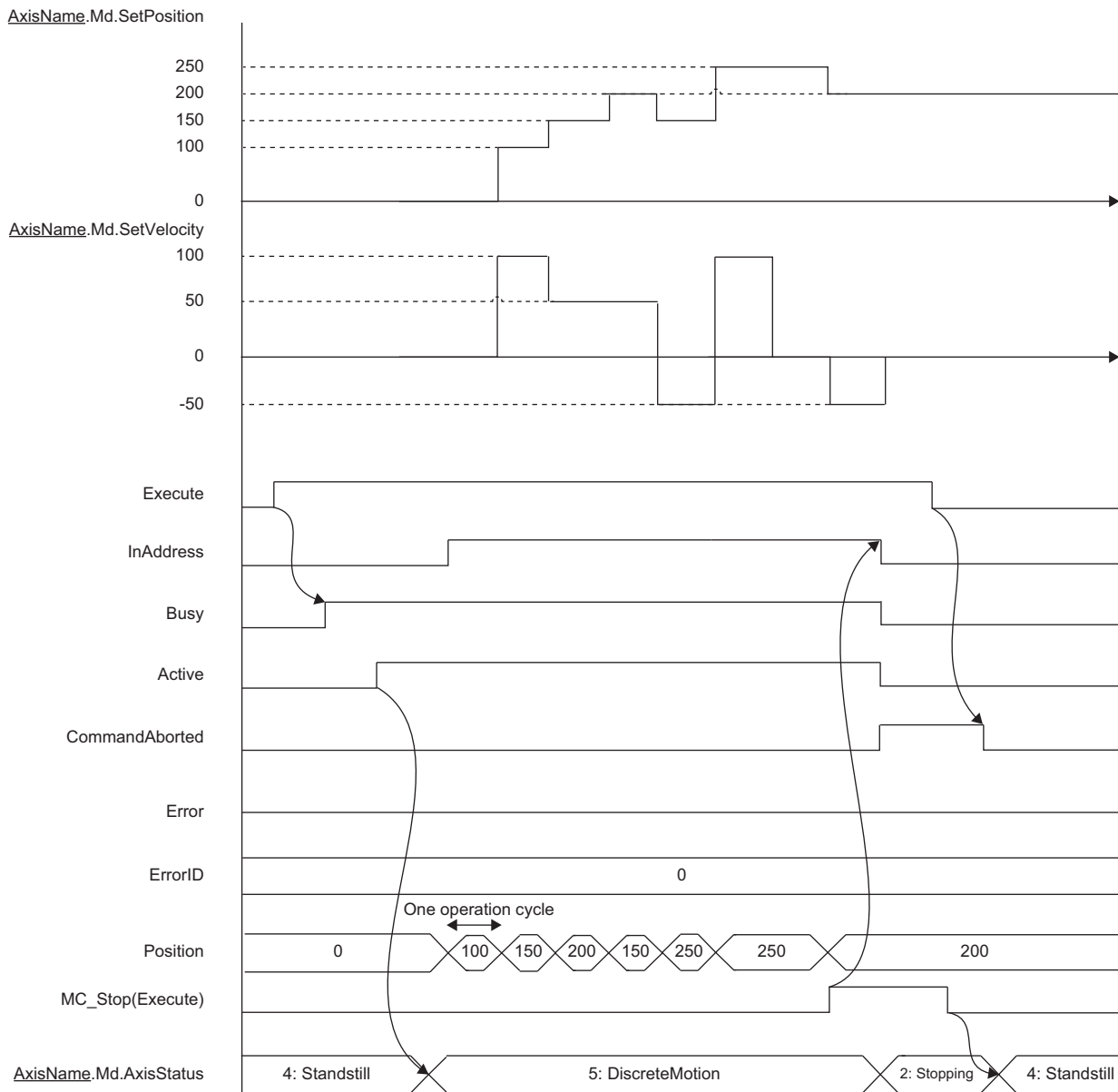
| Output variable | Name                    | Data type  | Default value | Description                                                                                                                                                                                                                                       |
|-----------------|-------------------------|------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InAddress       | Target position reached | BOOL       | FALSE         | This variable becomes TRUE when <u>AxisName.Md.SetPosition</u> reaches the target position.<br>This variable becomes FALSE when an error or a stop cause occurs.                                                                                  |
| Busy            | Executing               | BOOL       | FALSE         | This variable becomes TRUE when this FB is operating.                                                                                                                                                                                             |
| Active          | Controlling             | BOOL       | FALSE         | This variable becomes TRUE when this FB is controlling the axis.                                                                                                                                                                                  |
| CommandAborted  | Abortion of execution   | BOOL       | FALSE         | This variable becomes TRUE when execution is aborted by another FB.                                                                                                                                                                               |
| Error           | Error                   | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                  |
| ErrorID         | Error code              | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |

## Processing details

The control mode on the drive unit side is switched to csp (cyclic synchronous position mode), and the command position is sent. To stop this FB, use MC\_Stop (Forced Stop).

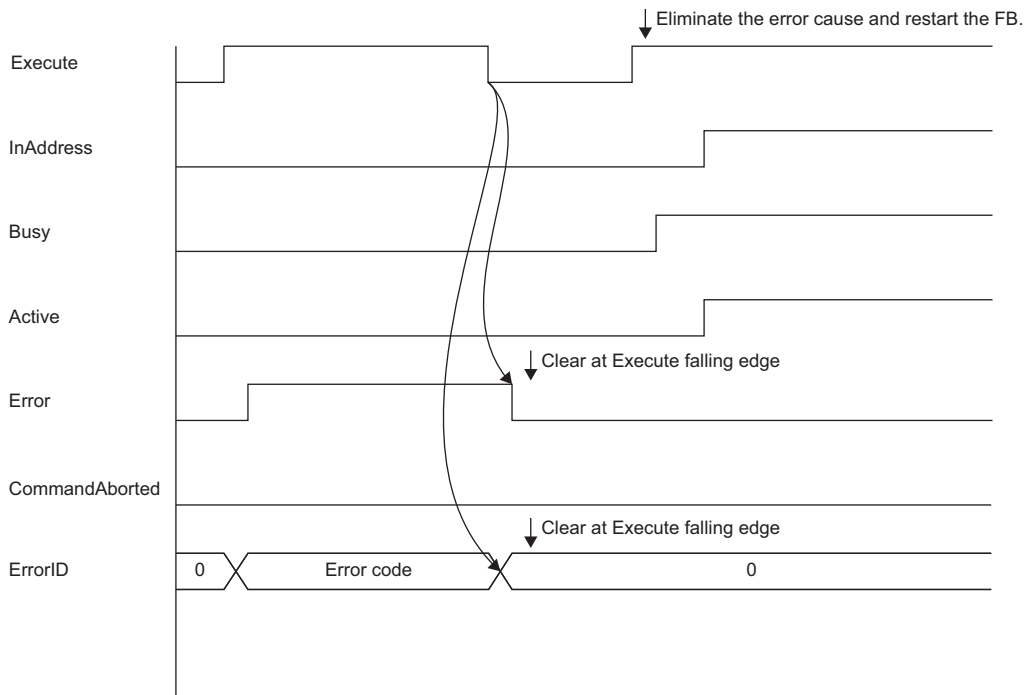
### ■ Timing chart

- When the processing is completed successfully

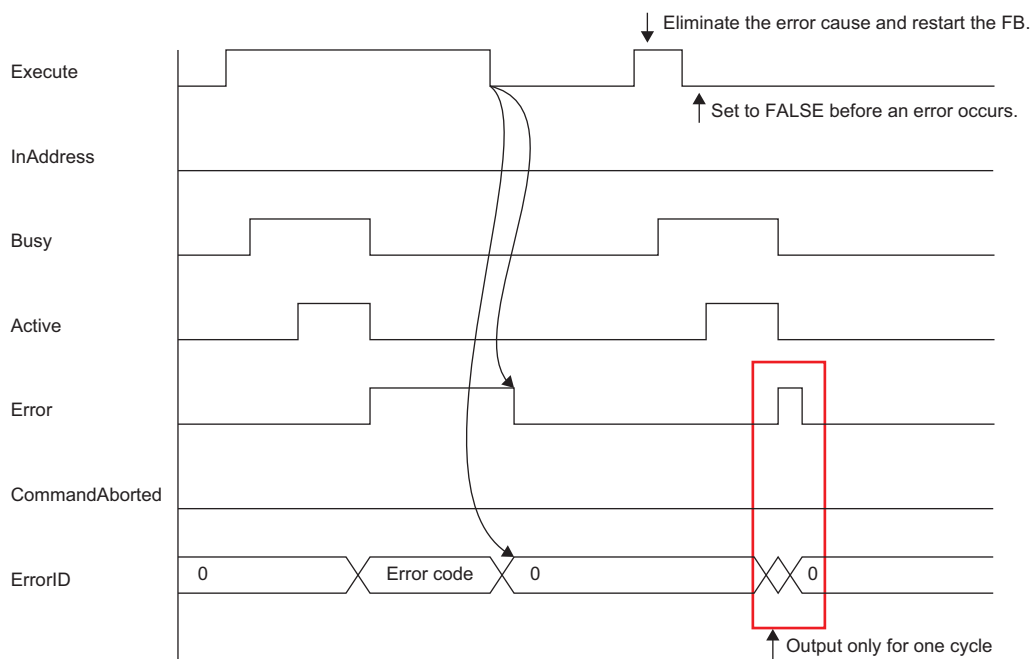




- When I/O variables are abnormal



- When an input variable is abnormal



## ■Target position (Position)

The target position of the absolute position is set in the positioning range. The following table summarizes the valid ranges. If a value outside the range is set, Out of target position range (error code: 1A85H) occurs.

| Ring counter setting | Valid range                                                                                                 |
|----------------------|-------------------------------------------------------------------------------------------------------------|
| Invalid              | $-10000000000.0 \leq \text{Target position} < 10000000000.0$                                                |
| Valid                | $\text{Ring counter lower limit value} \leq \text{Target position} < \text{Ring counter upper limit value}$ |

When the software stroke limit is valid (when Software stroke limit target (AxisName.Md.SwStrokeLimit\_Target) is set to a value other than "-1: Invalid (Invalid)"), positioning control is performed in a direction which does not cross over into the area outside the software stroke limit range. When the value does not cross over into the area outside the software stroke limit range both in the positive direction and the negative direction, positioning control is performed in the direction closest to the target position (the direction in which the absolute value of the movement amount is shortest) based on the current position. When the distance is the same between the positive direction and negative direction, the moving direction of the motion control FB executed previously or the moving direction at the previous target position change will be carried over for the operation. In addition, even when the value set is within the valid range, Software stroke limit over (target position) (error code: 1A80H) occurs if a position which exceeds the software stroke limit is specified as the target position.

When the software stroke limit is invalid (when Software stroke limit target (AxisName.Md.SwStrokeLimit\_Target) is set to "-1: Invalid (Invalid)"), refer to the following.

☞ Page 1937 Direction selection (Direction)

When changing Target position (Position), change it within the following range. If the setting is configured so that the value after the electronic gear conversion exceeds 31 bits, Out of the movement amount range after driver position unit conversion (error code: 1B3CH) occurs.

Change amount of target position  $\times$  Driver unit conversion numerator/Driver unit conversion denominator  $\leq 2000000000$

### Ex.

An example of calculating the target position under the following conditions is shown below.

| Item                     | Value                  |
|--------------------------|------------------------|
| Motor encoder resolution | 67108864 [pulse/rev]   |
| Worm gear pitch          | 1000 [ $\mu\text{m}$ ] |
| External gear ratio      | 1/10                   |

When the electronic gear settings specify the number of pulses per servo motor rotation as 67108864 [pulse] and the movement amount per servo motor rotation as 100.0 [ $\mu\text{m}$ ], the change amount of the target position is within or falls below the following range.

$$\begin{array}{l} \text{Target position} \\ \text{variation amount} \end{array} = 2000000000 \div \frac{\text{Driver unit conversion} \\ \text{numerator}}{\text{Driver unit conversion} \\ \text{denominator}} = 2000000000 \div \frac{\text{Number of pulses per} \\ \text{rotation}}{\text{Movement amount per} \\ \text{rotation}} = 2000000000 \div \frac{67108864}{100.0} = 2980.23\dots$$

## ■Direction selection (Direction)

When the software stroke limit is disabled, the direction used to move from the current position to the target position is specified.

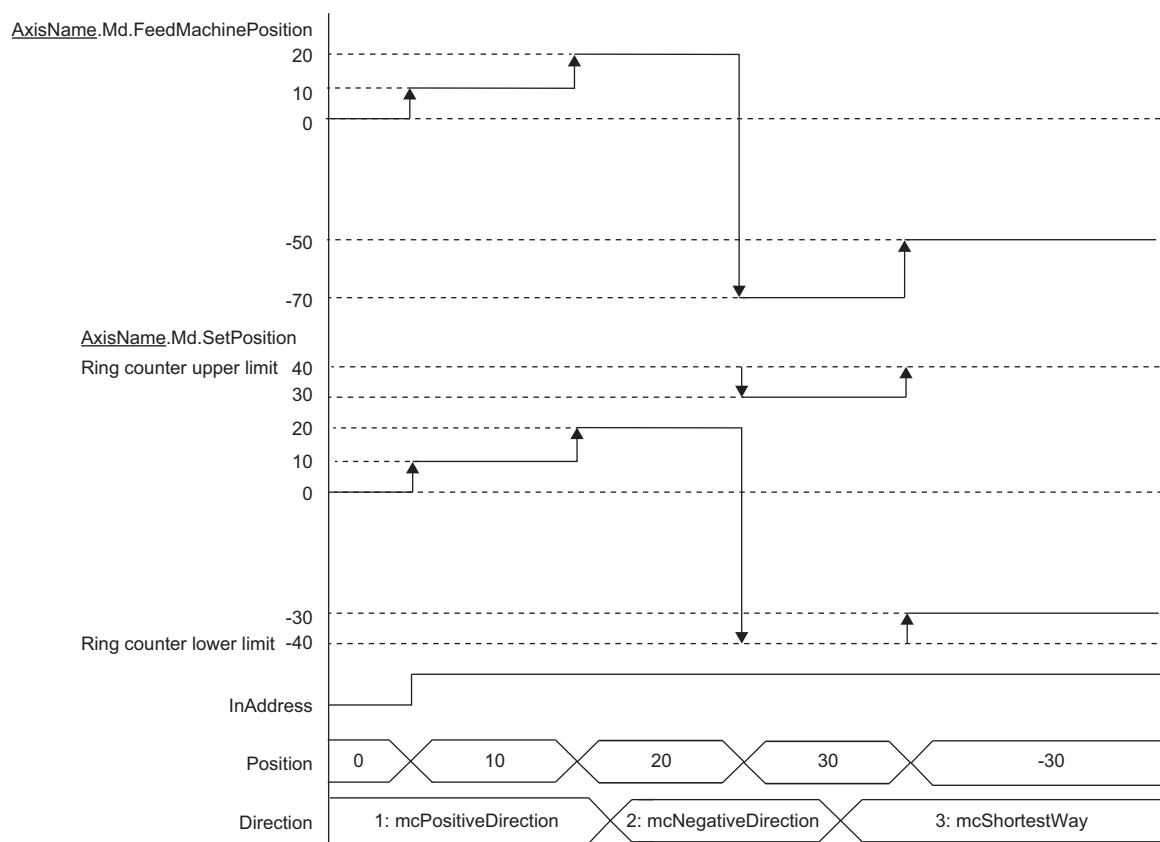
The setting range can be selected from "1: Positive direction (mcPositiveDirection)", "2: Negative direction (mcNegativeDirection)", and "3: Shortest path (mcShortestWay)".

The setting for Direction selection (Direction) is ignored when the software stroke limit is valid.

If a value outside the range is set for Direction selection (Direction) at start, Out of direction selection range (error code: 1AA5H) occurs and the axis will not start.

If a value outside the range is set for Direction selection (Direction) during control, Out of direction selection range warning (event code: 00D4DH) occurs and the operation continues with the previous setting. Also, if Target position (Position) is changed at the same time as Direction selection (Direction), the operation continues with the previous Target position (Position) setting.

For the moving direction according to Direction selection (Direction), the operation at the start of the motion control FB is based on the set position at the start, and the operation after the start of the motion control FB is based on the set position at the target position change.



- 1: Positive direction (mcPositiveDirection)

Performs positioning from the current position to the target position in the positive direction (address increasing).

| Setting range                                                         | Operation                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Current value $\leq$ Target position < Ring counter upper limit value | <p>The graph shows a sawtooth wave for the Ring counter. The y-axis ranges from -100.0 to 100.0, with 0.0 in the middle. The x-axis represents position. A solid line with an arrow points from the current value (0.0) to the target position (also 0.0), indicating no movement. The Ring counter upper limit value is at 100.0 and the lower limit value is at -100.0.</p>                            |
| Ring counter lower limit value $\leq$ Target position < Current value | <p>The graph shows two sawtooth waves. The top graph, labeled AxisName.Md.FeedMachinePosition, has a y-axis from -200 to 200. The bottom graph, labeled AxisName.Md.SetPosition, has a y-axis from -100 to 100. In both, the current value is 0.0. The target position is 200, which is beyond the upper limit of 100. The movement is shown as a solid line with an arrow pointing from 0.0 to 200.</p> |

- 2: Negative direction (mcNegativeDirection)

Performs positioning in the negative direction (address decreasing) from the current position to the target position.

| Setting range                                                              | Operation                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ring counter lower limit value $\leq$ Target position $\leq$ Current value | <p>The graph shows a sawtooth wave for the Ring counter. The y-axis ranges from -100.0 to 100.0, with 0.0 in the middle. The x-axis represents position. A solid line with an arrow points from the current value (0.0) to the target position (also 0.0), indicating no movement. The Ring counter upper limit value is at 100.0 and the lower limit value is at -100.0.</p>                             |
| Current value < Target position < Ring counter upper limit value           | <p>The graph shows two sawtooth waves. The top graph, labeled AxisName.Md.FeedMachinePosition, has a y-axis from -200 to 0. The bottom graph, labeled AxisName.Md.SetPosition, has a y-axis from -100 to 100. In both, the current value is 0.0. The target position is -200, which is beyond the lower limit of -100. The movement is shown as a solid line with an arrow pointing from 0.0 to -200.</p> |

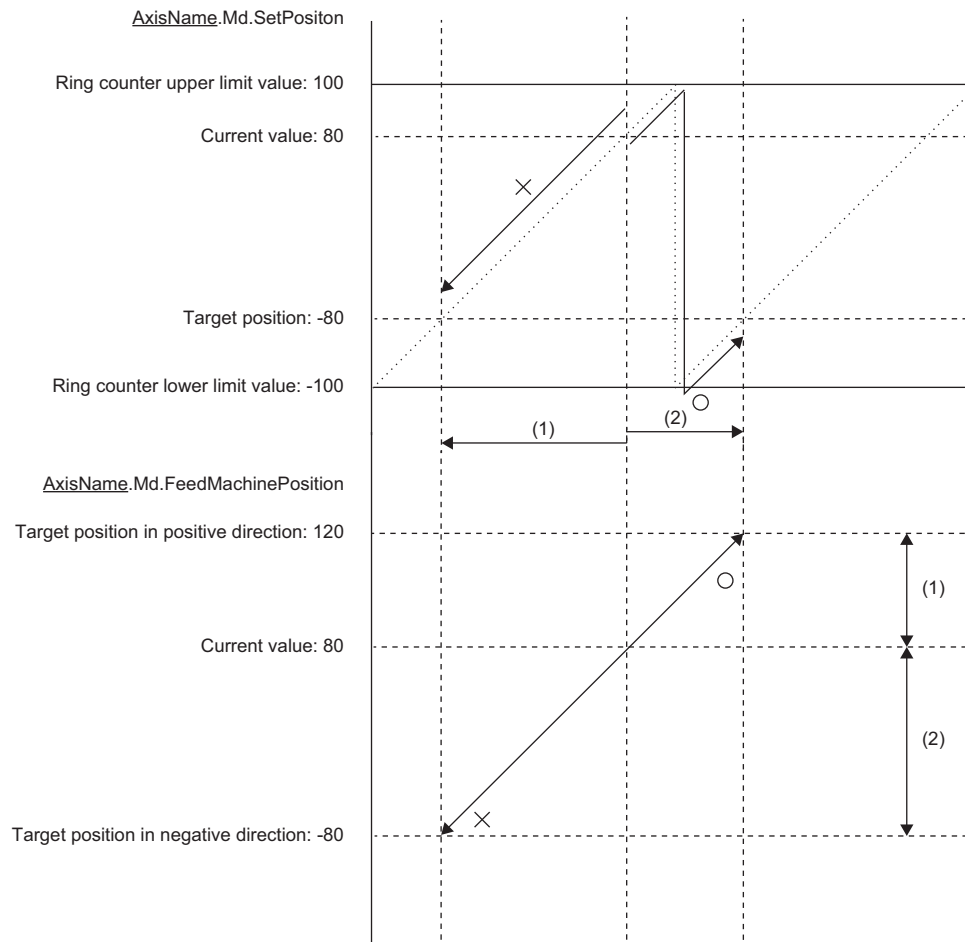
- 3: Shortest path (mcShortestWay)

Based on the current position, positioning control is performed in the direction closest to the target position (the direction in which the absolute value of the movement amount is shortest). If the distance is the same in both the positive direction and the negative direction, control is performed using the current direction. The setting range of the target position is "Ring counter lower limit value  $\leq$  Target position  $<$  Ring counter upper limit value". If a value outside the range is set, Out of target position range (error code: 1A85H) occurs and the axis will not start.

**Ex.**

Operation when set to the values shown below

- Ring counter upper limit value: 100.0
- Ring counter lower limit value: -100.0
- Current position: 80.0
- Target position: -80.0



Since the movement amount of (1) is "160.0" and the movement amount of (2) is "40.0", positioning moves in the positive direction from (2).

## ■Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following table shows the buffer modes that can be set for this FB.

| Setting value            | Description                                                                 |
|--------------------------|-----------------------------------------------------------------------------|
| 0: Aborting (mcAborting) | Aborts (cancels) the under-control FB and executes the next FB immediately. |

### Point

For details on multiple start (buffer mode), refer to the following.

 User's manual for the controller used

## Precautions

- The motion cyclic position control does not configure the settings for acceleration, deceleration, and jerk, which may result in sudden acceleration or deceleration when sending the command position. Therefore, set the following speed limit values with safety considerations: Positive Direction Speed Limit Value (AxisName.Pr.VelocityLimit\_Positive) for the positive direction and Negative Direction Speed Limit Value (AxisName.Pr.VelocityLimit\_Negative) for the negative direction.
- If the set velocity exceeds the speed limit value for each axis, the operation follows Operation Setting at Velocity Limit Value Exceeded (AxisName.Pr.VelocityLimit\_OverOperation). Also, if the absolute value of the set velocity exceeds the maximum velocity, Velocity range over during controlling (error code: 1B1AH) occurs and the operation stops.
- To switch from a control mode other than csp to csp using multiple starts of MCv\_CyclicPosition (Motion Cyclic Position Control), ensure that the motor has stopped before switching. If not, the difference between the current position and MCv\_CyclicPosition (Motion Cyclic Position Control) becomes large, and the sudden operation may occur.

## Program example

For a program example of this FB, refer to the following manual.

 User's manual for the controller used

# 46.27 Motion Cyclic Velocity Control

46

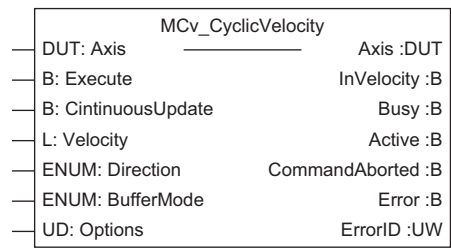
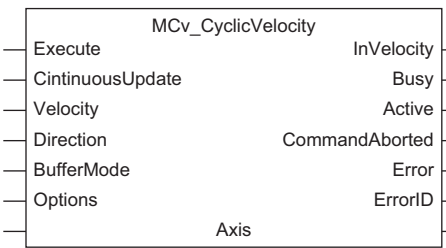
## MCv\_CyclicVelocity

This FB sends the target velocity to a drive unit according to the specified target velocity.

### Restriction

Before using this FB, check the versions of the controller and engineering tool.

 User's manual for the controller used

| Ladder diagram                                                                    | FBD/LD                                                                             | ST                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | <pre> MCv_CyclicVelocity(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   Velocity:= ?LREAL? ,   Direction:= ?INT? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   InVelocity=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                                                                                            |
|--------------|------------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable (AxisName.AxisRef.) used, refer to the following.<br> Page 1444<br>AxisName.AxisRef. (Axis information) |

## ■ Input variable

| Input variable    | Name                | Data type      | Input                                                          | Valid range                                                                                   | Default value | Description                                                                                                                                                                                       |
|-------------------|---------------------|----------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute           | Execution command   | BOOL           | At start                                                       | —                                                                                             | FALSE         | This FB is executed when the value is TRUE.                                                                                                                                                       |
| Continuous Update | Continuous update   | BOOL           | At start                                                       | —                                                                                             | FALSE         | The target position can be continuously changed while the value is TRUE.                                                                                                                          |
| Velocity          | Target velocity     | LREAL          | At start/<br>Retrigger possible/<br>Continuous update possible | -2500000000.0 to 2500000000.0                                                                 | 0             | The target velocity is set. For details, refer to the following.<br> Page 1945 Target velocity (Velocity)      |
| Direction         | Direction selection | MC_DIRECTION   | At start                                                       | mcPositiveDirection (Positive direction) (1),<br>mcNegativeDirection (Negative direction) (2) | 0             | The direction is specified. For details, refer to the following.<br> Page 1945 Direction selection (Direction) |
| BufferMode        | Buffer mode         | MC_BUFFER_MODE | At start                                                       | mcAborting                                                                                    | mcAborting    | The buffer mode is set. For details, refer to the following.<br> Page 1945 Buffer mode (BufferMode)            |
| Options           | Options             | DWORD(HEX)     | At start                                                       | Fixed to 0                                                                                    | 0             | This variable cannot be set for this FB. Set 0. If a value other than 0 is set, Out of options range (error code: 1ABBH) occurs.                                                                  |

## ■ Output variables

| Output variable | Name                    | Data type  | Default value | Description                                                                                                                                                                                                                                       |
|-----------------|-------------------------|------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InVelocity      | Target velocity reached | BOOL       | FALSE         | This variable becomes TRUE when <u>AxisName</u> .Md.IO_TargetVelocity reaches the target velocity.<br>This variable becomes FALSE when an error or a stop cause occurs.                                                                           |
| Busy            | Executing               | BOOL       | FALSE         | This variable becomes TRUE when this FB is being executed.                                                                                                                                                                                        |
| Active          | Controlling             | BOOL       | FALSE         | This variable becomes TRUE when this FB is controlling the axis.                                                                                                                                                                                  |
| CommandAborted  | Abortion of execution   | BOOL       | FALSE         | This variable becomes TRUE when execution is aborted by another FB.                                                                                                                                                                               |
| Error           | Error                   | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                  |
| ErrorID         | Error code              | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |

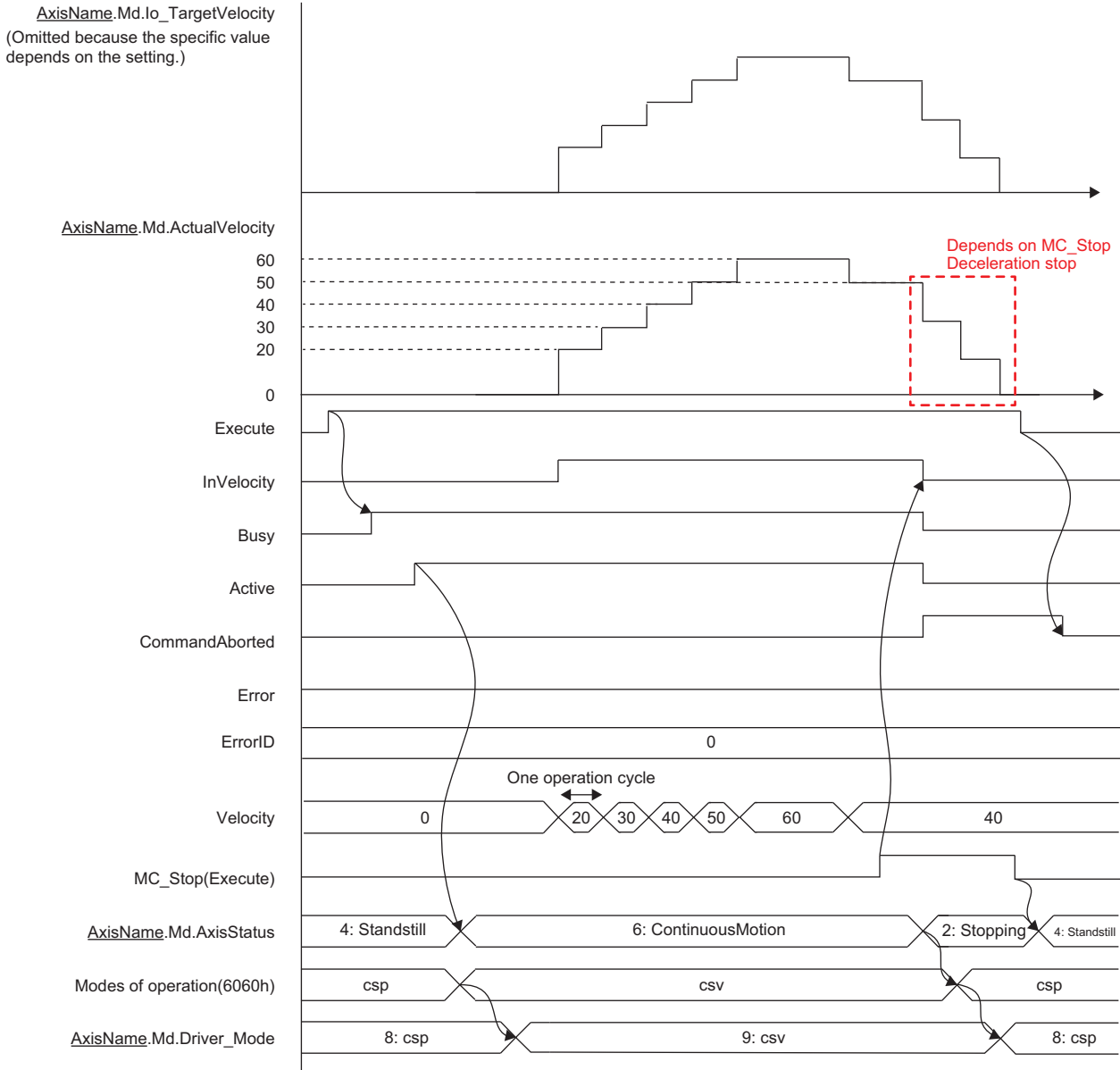


## Processing details

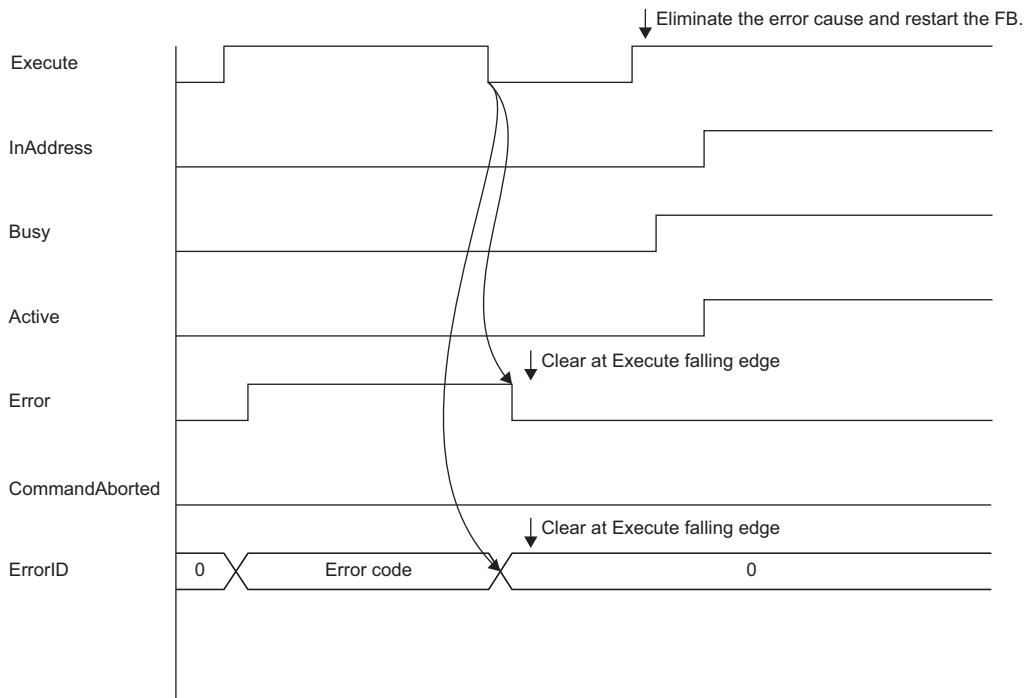
The control mode on the drive unit side is switched to csv (cyclic synchronous velocity mode), and the command velocity is sent. To stop this FB, use MC\_Stop (Forced Stop).

### ■Timing chart

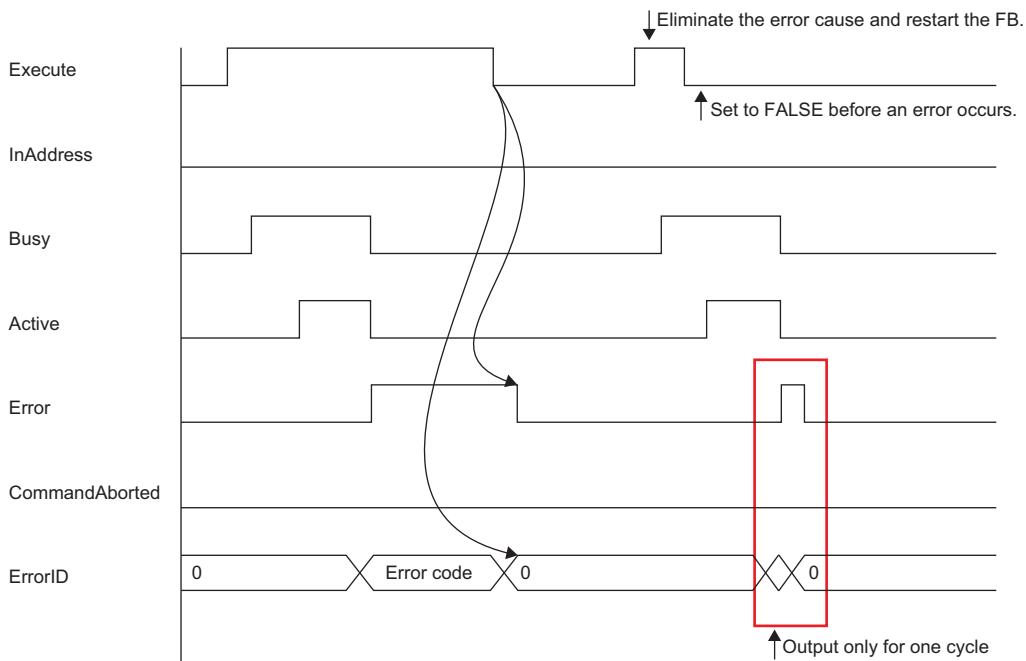
- When the processing is completed successfully



- When I/O variables are abnormal



- When an input variable is abnormal



### ■Target velocity (Velocity)

The target velocity is set. If a value outside the range is set at the start, Out of velocity range (error code: 1ABAH) occurs. If a value outside the range is set during control, Out of velocity range warning (event code: 00D0FH) occurs.

Set the value so that the command velocity after driver velocity unit conversion falls within the range from -2147483648 to 2147483647. If the command velocity after conversion is outside the range, Set velocity of converted driver velocity unit out of range (error code: 1A90H) occurs regardless of the operation status.

The command velocity after driver velocity unit conversion is determined by the following equation:

Command velocity after driver velocity unit conversion = Velocity command unit × (Driver unit conversion numerator ÷ Driver unit conversion denominator)

When the velocity is set to a negative value, the axis moves in the negative direction.

When 0 is set at the start, the axis does not operate, but Axis status (AxisName.Md.AxisStatus) of the target axis changes to "6: During continuous operation (ContinuousMotion)".

When this FB is started multiple times and Target velocity (Velocity) is set to 0, the axis operates at the command velocity of the previous motion control FB.

### ■Direction selection (Direction)

The direction used to move from the current position to the target position is specified.

The setting range can be selected from "1: Positive direction (mcPositiveDirection)", "2: Negative direction (mcNegativeDirection)", and "3: Shortest path (mcShortestWay)". When "2: Negative direction (mcNegativeDirection)" is set and Target velocity (Velocity) is set to a negative value, the movement direction of the motor will be positive.

If a value outside the range is set for Direction selection (Direction) at start, Out of direction selection range (error code: 1AA5H) occurs and the axis will not start.

### ■Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following table shows the buffer modes that can be set for this FB.

| Setting value            | Description                                                                 |
|--------------------------|-----------------------------------------------------------------------------|
| 0: Aborting (mcAborting) | Aborts (cancels) the under-control FB and executes the next FB immediately. |

#### Point

For details on multiple start (buffer mode), refer to the following.

 User's manual for the controller used

### Precautions

When setting the target velocity, set the value so that the difference between the current velocity and the target velocity is not too large. If the difference is too large, the axis may suddenly accelerate.

When a stop cause occurs while this FB is starting, the axis will stop immediately.

### Program example

For a program example of this FB, refer to the following.

 User's manual for the controller used

# 46.28 Motion Cyclic Torque Control

## MCv\_CyclicTorque

The target torque is sent to the drive unit according to the specified target torque.



Before using this FB, check the versions of the controller and engineering tool.

User's manual for the controller used

| Ladder diagram | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                       |
|----------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |        | <pre> MCv_CyclicTorque(   Axis:= ?AXIS_REF? ,   Execute:= ?BOOL? ,   ContinuousUpdate:= ?BOOL? ,   Torque:= ?LREAL? ,   LimitVelocity:= ?LREAL? ,   BufferMode:= ?INT? ,   Options:= ?DWORD? ,   InTorque=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Active=&gt; ?BOOL? ,   CommandAborted=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

## Setting data

### I/O variables

| I/O variable | Name             | Data type | Input    | Valid range | Default value         | Description                                                                                                                                                    |
|--------------|------------------|-----------|----------|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Axis         | Axis information | AXIS_REF  | At start | —           | Omission not possible | An axis is specified.<br>For the variable ( <u>AxisName</u> .AxisRef.) used, refer to the following.<br>Page 1444 <u>AxisName</u> .AxisRef. (Axis information) |

### Input variable

| Input variable    | Name              | Data type      | Input                                                      | Valid range                   | Default value | Description                                                                                                                               |
|-------------------|-------------------|----------------|------------------------------------------------------------|-------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Execute           | Execution command | BOOL           | At start                                                   | —                             | FALSE         | This FB is executed when the value is TRUE.                                                                                               |
| Continuous Update | Continuous update | BOOL           | At start                                                   | —                             | FALSE         | The target position can be continuously changed while the value is TRUE.                                                                  |
| Torque            | Target torque     | LREAL          | At start/Retrigger possible/<br>Continuous update possible | -1000.0 to 1000.0 [%]         | 0             | The ratio of the servo motor used to the rated torque is set.<br>For details, refer to the following.<br>Page 1950 Target torque (Torque) |
| LimitVelocity     | Limit velocity    | LREAL          | At start/Retrigger possible/<br>Continuous update possible | -2500000000.0 to 2500000000.0 | 0             | The direction is specified.<br>For details, refer to the following.<br>Page 1951 Limit velocity (LimitVelocity)                           |
| BufferMode        | Buffer mode       | MC_BUFFER_MODE | At start                                                   | mcAborting                    | mcAborting    | The buffer mode is set.<br>For details, refer to the following.<br>Page 1951 Buffer mode (BufferMode)                                     |
| Options           | Options           | DWORD(HEX)     | At start                                                   | Fixed to 0                    | 0             | This variable cannot be set for this FB. Set 0. If a value other than 0 is set, Out of options range (error code: 1ABBH) occurs.          |

## ■ Output variables

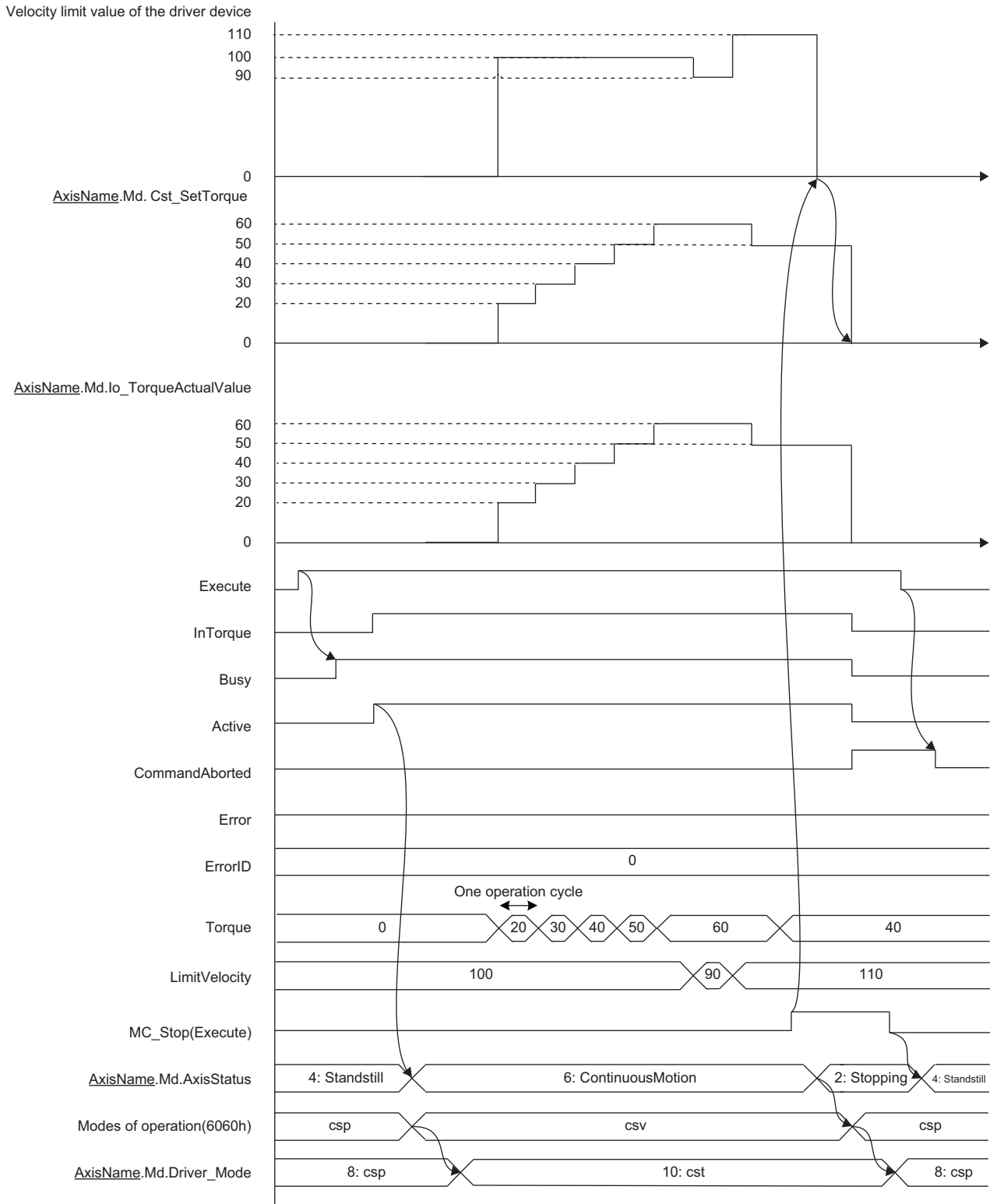
| Output variable | Name                  | Data type  | Default value | Description                                                                                                                                                                                                                                     |
|-----------------|-----------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InTorque        | Target torque reached | BOOL       | FALSE         | This variable becomes TRUE when Cst_SetTorque sent from a drive unit reaches the target torque. This variable becomes FALSE after the axis stops due to error or stop cause occurrence.                                                         |
| Busy            | Executing             | BOOL       | FALSE         | This variable becomes TRUE when this FB is operating.                                                                                                                                                                                           |
| Active          | Controlling           | BOOL       | FALSE         | This variable becomes TRUE when this FB is controlling the axis.                                                                                                                                                                                |
| CommandAborted  | Abortion of execution | BOOL       | FALSE         | This variable becomes TRUE when execution is aborted by another FB.                                                                                                                                                                             |
| Error           | Error                 | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                |
| ErrorID         | Error code            | WORD(UINT) | 0             | When an error occurs, this variable returns the error code.<br>For details on error codes, refer to the following.<br> User's manual for the controller used |

## Processing details

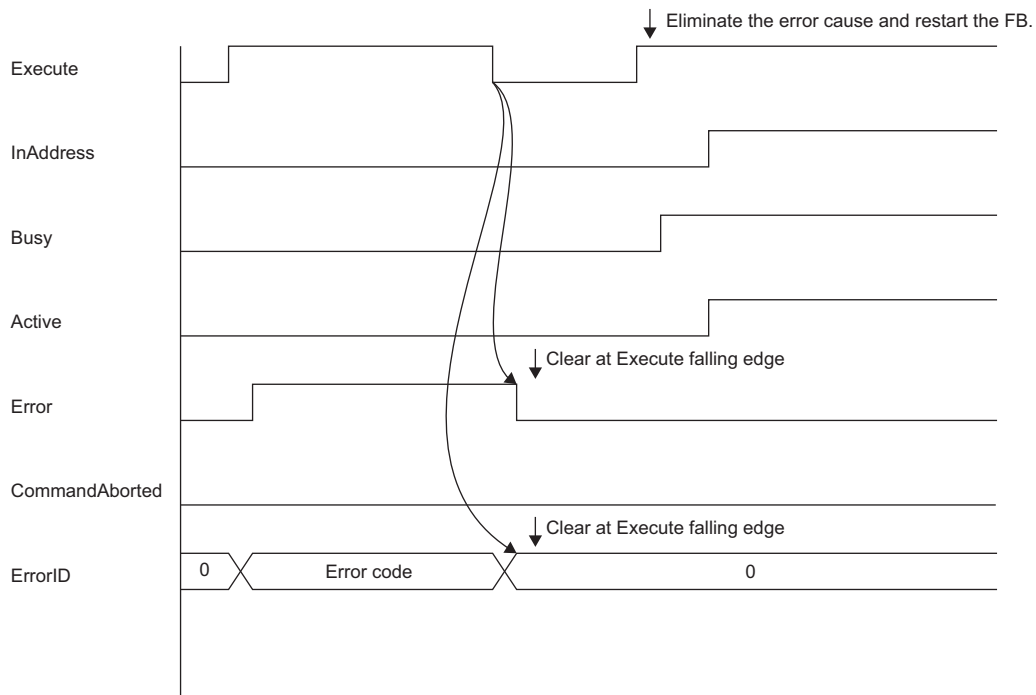
The control mode on the drive unit side is switched to cst (cyclic synchronous torque mode), and the command velocity is sent. To stop this FB, use MC\_Stop (Forced Stop).

### ■Timing chart

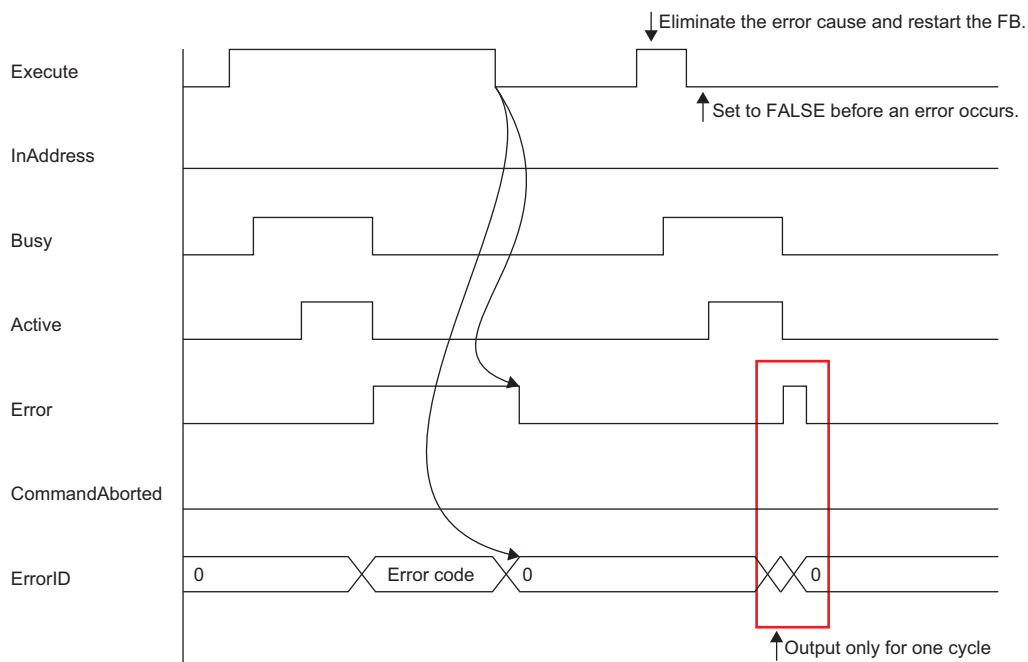
- When the processing is completed successfully



- When I/O variables are abnormal



- When an input variable is abnormal



## ■Target torque (Torque)

The ratio of the servo motor used to the rated torque is set in percentage.

If a value outside the range is set at the start, Out of target torque range (error code: 1A96H) occurs.

If a value outside the range is set during control, Out of torque setting range warning (event code: 00D16H) occurs.

The number of significant digits for the target torque varies depending on the specifications for Target Torque of the connected drive unit. If the value set for the target torque contains a value equal to or less than the number of significant digits of Target Torque, it is rounded down.

To output the command torque in the positive direction (address increasing direction), set a positive value. To output the command torque in the negative direction (address decreasing direction), set a negative value.

To reverse the target torque direction for safety reasons, set the target torque to 0 once.

### Ex.

To change the target torque from -10.0 to 10.0, change the value in the following order.

-10.0 → 0.0 → 10.0



## ■Limit velocity (LimitVelocity)

The velocity limit value for the cyclic synchronous torque mode is set in the range from -2500000000.0 to 2500000000.0. If a value outside the range is set, Out of limit velocity range (error code: 1A86H) occurs at start, and Out of limit velocity range warning (event code: 00D1BH) occurs during control.

Set the value so that the command velocity after driver velocity unit conversion does not go out of the range from -2147483648 to 2147483647 [0.01rpm]. If a value outside the range is set, Set velocity of converted driver velocity unit out of range (error code: 1A90H) occurs.

The command velocity after driver velocity unit conversion is determined by the following equation:

Command velocity after driver velocity unit conversion = Velocity command unit × (Driver unit conversion numerator ÷ Driver unit conversion denominator)

When 0 is set at the start, the axis does not operate, but Axis status (AxisName.Md.AxisStatus) of the target axis changes to "6: During continuous operation (ContinuousMotion)".

When MC\_CyclicTorque (torque control) is executed by multiple start and 0 is stored in LimitVelocity (LimitVelocity), the motor speed of the previous motion control FB is controlled as Limit velocity (LimitVelocity).

Limit velocity (LimitVelocity) becomes valid when the following conditions are met.

- An object corresponding to Limit velocity (LimitVelocity) during cyclic synchronous torque mode (cst) for the connected drive unit is mapped and assigned to a PDO.
- The mapped object data is set to vVelLimitValue (AxisName.PrConst.SlaveObject.vVelLimitValue).

The setting method for enabling the velocity limit with Limit velocity (LimitVelocity) varies depending on the drive unit.

- When using the MR-J5(W)-G, map and assign Velocity limit value to a PDO.
- When using a drive unit other than the MR-J5(W)-G, map and assign an object corresponding to the limit velocity during cyclic synchronous torque mode (cst) for the connected drive unit to a PDO. Then, set the mapped object data to vVelLimitValue (AxisName.PrConst.SlaveObject.vVelLimitValue).

When the velocity limit in Limit velocity (LimitVelocity) is invalid, the velocity limit of the controller cannot be valid.

- When using the MR-J5(W)-G, use an engineering tool to set the setting value of the servo parameter [Pr.PT67 Speed limit].
- When using a drive unit other than the MR-J5(W)-G, use the velocity limit function of the connected drive unit. For details, refer to the user's manual for the connected drive unit.

## ■Buffer mode (BufferMode)

Sets the operation used to perform multiple start (buffer mode).

The following table shows the buffer modes that can be set for this FB.

| Setting value            | Description                                                                 |
|--------------------------|-----------------------------------------------------------------------------|
| 0: Aborting (mcAborting) | Aborts (cancels) the under-control FB and executes the next FB immediately. |

### Point

For details on multiple start (buffer mode), refer to the following.

 User's manual for the controller used

## Precautions

- The set position and the feed machine position are updated by follow up.
- The switching time of the control mode by this FB varies depending on the specifications for the drive unit used.
- When a stop cause occurs while this FB is starting, the axis will stop immediately.
- Do not start a positioning control FB while this FB is operating. Check that Driver control mode (AxisName.Md.Driver\_Mode) has switched to "10: Torque control (cst)" before starting the positioning control FB.
- If the torque set as the target torque is insufficient, the torque may suddenly drop depending on the mechanism or load. When setting a small value for the target torque, take sufficient care for safety.
- When the axis stops, store the value in Limit velocity (LimitVelocity) after checking that the control mode is switched. If the value is already stored in Limit velocity (LimitVelocity) before the mode is switched, the velocity may suddenly increase, creating a dangerous situation.
- Limit velocity (LimitVelocity) is recommended during cst. When Limit velocity (LimitVelocity) is not used, a large difference between the current torque and the target torque may cause the velocity to suddenly increase, depending on the mechanism and load application, creating a dangerous situation.
- For the torque limit change during cst, pay attention to the operations when the following changes are made.

| Change content                                                                                                                                                                                                                                                                         | Operation                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| At restart or continuous update, the target torque was changed to a value bigger than the torque limit value (Positive direction torque limit value ( <u>AxisName.Md.TorqueLimit_Positive</u> ) or Negative direction torque limit value ( <u>AxisName.Md.TorqueLimit_Negative</u> )). | Torque limit value over warning (event code: 00D12H) occurs, and the operation is performed with the value before the change. |
| During torque control, Positive direction torque limit value ( <u>AxisName.Cd.TorqueLimit_Positive</u> ) or Negative direction torque limit value ( <u>AxisName.Cd.TorqueLimit_Negative</u> ) was changed to a value smaller than the target torque.                                   | The target torque is changed to the torque limit value. In this case, the command torque is changed in one operation cycle.   |

- While this FB is operating, the continuous operation to torque control mode cannot be switched by multiple starts of MC\_TorqueControl (Torque control). When the control mode is switched, Control mode switching disabled warning (event code: 00D31H) occurs and the operation is performed in the current control mode.
- This FB cannot be executed during the continuous operation to torque control. If the control mode is switched, Control mode switching error (error code: 1A95H) occurs.
- When the control mode is switched from cst using multiple starts of MCv\_CyclicTorque (Motion Cyclic Torque Control), the command torque set in MCv\_CyclicTorque (Motion Cyclic Torque Control) is immediately sent. Set a value so that the difference between the command torque and speed limit before and after multiple starts does not become large. If the difference is large, the sudden operation may occur.

## Program example

For a program example of this FB, refer to the following.

 User's manual for the controller used

## 47.1 Profile Read

### MCv\_ReadProfileData

This FB reads the specified operation profile data from the open area or a file.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                               |
|--------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MCv_ReadProfileData(   ProfileData:= ?PROFILE_DATA? ,   Data1:= ?TARGET_REF? ,   Data2:= ?TARGET_REF? ,   Execute:= ?BOOL? ,   Offset:= ?DWORD? ,   Points:= ?DWORD? ,   Target:= ?WORD? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name         | Data type    | Input    | Setting range | Default value         | Description                                                                                                                                                                                                                                                                                        |
|--------------|--------------|--------------|----------|---------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ProfileData  | Profile data | PROFILE_DATA | At start | —             | Omission not possible | The operation profile data to be read is set.<br>The operation profile data is set with a PROFILE_DATA structure. For the PROFILE_DATA structure, refer to the following.<br>☞ Page 1492 PROFILE_DATA<br>The operation profile data in which the read data structure has been defined can be read. |
| Data1        | Read data 1  | TARGET_REF   | At start | —             | Omission not possible | The read data structure suitable for the operation profile data format to be read is set.<br>For details, refer to the following.<br>☞ Page 1962 Read data 1 (Data1)/Read data 2 (Data2)                                                                                                           |
| Data2        | Read data 2  | TARGET_REF   | At start | —             | Omission not possible | The read data structure suitable for the operation profile data format to be read is set.<br>For details, refer to the following.<br>☞ Page 1962 Read data 1 (Data1)/Read data 2 (Data2)                                                                                                           |

## Input variables

| Input variable | Name                | Data type    | Input    | Setting range                   | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------|---------------------|--------------|----------|---------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute        | Start               | BOOL         | At start | TRUE, FALSE                     | FALSE         | When this variable is set to TRUE, MCv_ReadProfileData (Profile Read) is executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Offset         | Offset              | DWORD(UDINT) | At start | 0 to resolution<br>(2 to 65535) | 0             | <p>The offset from the start of the operation profile data is set.</p> <p>If Offset (Offset) exceeds the range of the operation profile data, Out of Offset Range (error code: 1B92H) occurs and reading will not be performed.</p> <p>When a value other than "0" is set, set a value other than "0" to Number of read data (Points). (When "0" is set to Number of read data (Points), Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs.)</p> <p>* The read operation differs depending on the set values set to Offset (Offset) and Number of read data (Points). For details, refer to the following.</p> <p> Page 1956 Offset (Offset) and Number of read data (Points) setting</p> |
| Points         | Number of read data | DWORD(UDINT) | At start | 0 to 4294967295                 | 0             | <p>The number of read data points is set.</p> <p>When Number of read data (Points) exceeds the number of elements in the operation profile data, the operation profile data for the number of elements is read.</p> <p>When Interpolation method specification (Interpolate) of the operation profile data is set to "1: Specifying for each section" or "2: Spline interpolation", set "0". (When a value other than "0" is set, Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs.)</p>                                                                                                                                                                                                 |
| Target         | Read destination    | WORD(UINT)   | At start | 0, 1, 2                         | 0             | <p>The read destination of the operation profile data is set.</p> <ul style="list-style-type: none"> <li>• 0: Open area</li> <li>• 1: File</li> <li>• 2: Open area (motion service processing)</li> </ul> <p>For details, refer to the following.</p> <p> Page 1964 Read destination (Target)</p>                                                                                                                                                                                                                                                                                                                                                                                                             |

## Output variables

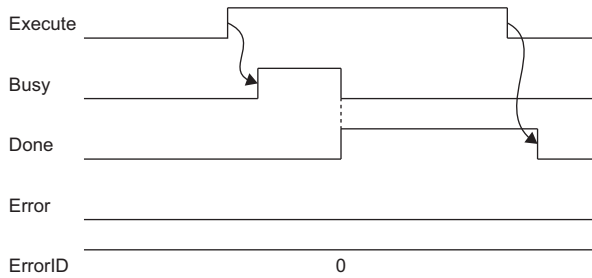
| Output variable | Name       | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                                         |
|-----------------|------------|------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Completion | BOOL       | FALSE         | <p>This variable becomes TRUE when the control is completed.</p> <p>The value differs depending on the status of Start (Execute) at operation completion.</p> <p>■ When Start (Execute) is TRUE<br/>This variable remains TRUE until Start (Execute) is set to FALSE.</p> <p>■ When Start (Execute) is FALSE<br/>This variable becomes TRUE only for one cycle.</p> |
| Busy            | Executing  | BOOL       | FALSE         | This variable becomes TRUE when MCv_ReadProfileData (Profile Read) is executed.                                                                                                                                                                                                                                                                                     |
| Error           | Error      | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                                    |
| ErrorID         | Error code | WORD(UINT) | 0             | <p>When an error occurs, this variable returns the error code.</p> <p>For details on error codes, refer to the following.</p> <p> User's manual for the controller used</p>                                                                                                                                                                                         |

## Processing details

- This FB reads the operation profile data.
- The file specified in Profile data (ProfileData) and Read destination (Target), or the operation profile data in the open area are read for the number of points specified in Number of read data (Points) from the data specified with Offset (Offset).
- To read the whole operation profile data, specify "0" in both Offset (Offset) and Number of read data (Points).
- Read data is stored in variables specified in Read data 1 (Data1) and Read data 2 (Data2).

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

👉 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■Offset (Offset) and Number of read data (Points) setting

The following operations are based on the values set in Offset (Offset) and Number of read data (Points).

| Offset (Offset) | Number of read data (Points) | Size relationship with the number of elements of the operation profile data                                                 | Operation                                                                                                           |
|-----------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| 0               | 0                            | —                                                                                                                           | Reads all operation profile data elements.                                                                          |
|                 | Other than 0                 | $\text{Offset (Offset)} + \text{Number of read data (Points)} \leq \text{number of elements of the operation profile data}$ | Reads the number of operation profile data elements set in Number of read data (Points) from the top.               |
|                 | Other than 0                 | $\text{Offset (Offset)} + \text{Number of read data (Points)} > \text{number of elements of the operation profile data}$    | Reads all operation profile data elements.                                                                          |
| Other than 0    | 0                            | $\text{Offset (Offset)} \leq \text{number of elements of the operation profile data}$                                       | Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs, and read is not executed.                    |
|                 | Other than 0                 | $\text{Offset (Offset)} + \text{Number of read data (Points)} \leq \text{number of elements of the operation profile data}$ | Reads the number of operation profile data elements specified in Number of read data (Points) from Offset (Offset). |
|                 | Other than 0                 | $\text{Offset (Offset)} + \text{Number of read data (Points)} > \text{number of elements of the operation profile data}$    | Reads until the final element of the operation profile data from Offset (Offset).                                   |
|                 | —                            | $\text{Offset (Offset)} > \text{number of elements of the operation profile data}$                                          | Out of Offset Range (error code: 1B92H) occurs, and read is not executed.                                           |

The contents of the values set for Offset (Offset) and Number of read data (Points) vary depending on the operation profile data format.

The following describes the contents when "cam data" and "rotary cutter" are set to the operation profile data format.

- When the operation profile data format is "cam data"

| Specifying interpolation method (Interpolate) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                               |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------|---------------|-----|------------------------------|-------------------------------|-----|------------------------------|-------------------------------|-----|------------------------------|-------------------------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|--|------------------------------|-------------------------------|--|------------------------------|-------------------------------|--|------------------------------|-------------------------------|--|------------------------------|-------------------------------|--|------------------------------|-------------------------------|--|------------------------------|-------------------------------|--|------------------------------|-------------------------------|--|------------------------------|-------------------------------|
| 0: Linear interpolation                       | <p>Sets the top of the coordinate to be read in Offset (Offset), and the number of coordinates in Number of read data (Points).</p> <p>The data stored in Read data 1 (Data1) is the PROFILE_CAM_DATA type data when Specifying interpolation method (Interpolate) is "0: Linear interpolation".</p> <p>The data stored in Read data 2 (Data2) is data defined by using set coordinate data (a pair of input value (current value per cycle) and output value (stroke)) in LREAL type two-dimensional array.</p> <p>&lt;Example&gt;</p> <p>Read result of Read data 2 (Data2) when Offset (Offset) is set to "2" and Number of read data (Points) is set to "3".</p> <p>(When the variable set to Read data 2 (Data2) is a "LREAL[1..8,1..2]" data type "CamData2" label.)</p> <div><p style="text-align: center;">&lt;Variable (label/device)&gt;<br/>Two-dimensional array label of LREAL type<br/>(CamData2[1..8,1..2])</p><div><table><thead><tr><th></th><th>CamData[n][1]</th><th>CamData[n][2]</th></tr></thead><tbody><tr><td>n=1</td><td>Input value at the 2nd point</td><td>Output value at the 2nd point</td></tr><tr><td>n=2</td><td>Input value at the 3rd point</td><td>Output value at the 3rd point</td></tr><tr><td>n=3</td><td>Input value at the 4th point</td><td>Output value at the 4th point</td></tr><tr><td>n=4</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=5</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=6</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=7</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=8</td><td>Not updating</td><td>Not updating</td></tr></tbody></table></div><div><p style="text-align: right;">&lt;Open area/file&gt;*1</p><table><thead><tr><th></th><th>Input value at the 0th point</th><th>Output value at the 0th point</th></tr></thead><tbody><tr><td></td><td>Input value at the 1st point</td><td>Output value at the 1st point</td></tr><tr><td></td><td>Input value at the 2nd point</td><td>Output value at the 2nd point</td></tr><tr><td></td><td>Input value at the 3rd point</td><td>Output value at the 3rd point</td></tr><tr><td></td><td>Input value at the 4th point</td><td>Output value at the 4th point</td></tr><tr><td></td><td>Input value at the 5th point</td><td>Output value at the 5th point</td></tr><tr><td></td><td>Input value at the 6th point</td><td>Output value at the 6th point</td></tr><tr><td></td><td>Input value at the 7th point</td><td>Output value at the 7th point</td></tr></tbody></table></div><div><p>Offset</p><p>Number of read data (Points)</p></div></div> <div><p>*1: Depends on Read destination (Target).</p></div> |                               | CamData[n][1] | CamData[n][2] | n=1 | Input value at the 2nd point | Output value at the 2nd point | n=2 | Input value at the 3rd point | Output value at the 3rd point | n=3 | Input value at the 4th point | Output value at the 4th point | n=4 | Not updating | Not updating | n=5 | Not updating | Not updating | n=6 | Not updating | Not updating | n=7 | Not updating | Not updating | n=8 | Not updating | Not updating |  | Input value at the 0th point | Output value at the 0th point |  | Input value at the 1st point | Output value at the 1st point |  | Input value at the 2nd point | Output value at the 2nd point |  | Input value at the 3rd point | Output value at the 3rd point |  | Input value at the 4th point | Output value at the 4th point |  | Input value at the 5th point | Output value at the 5th point |  | Input value at the 6th point | Output value at the 6th point |  | Input value at the 7th point | Output value at the 7th point |
|                                               | CamData[n][1]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CamData[n][2]                 |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
| n=1                                           | Input value at the 2nd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output value at the 2nd point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
| n=2                                           | Input value at the 3rd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output value at the 3rd point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
| n=3                                           | Input value at the 4th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output value at the 4th point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
| n=4                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Not updating                  |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
| n=5                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Not updating                  |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
| n=6                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Not updating                  |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
| n=7                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Not updating                  |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
| n=8                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Not updating                  |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
|                                               | Input value at the 0th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output value at the 0th point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
|                                               | Input value at the 1st point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output value at the 1st point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
|                                               | Input value at the 2nd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output value at the 2nd point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
|                                               | Input value at the 3rd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output value at the 3rd point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
|                                               | Input value at the 4th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output value at the 4th point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
|                                               | Input value at the 5th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output value at the 5th point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
|                                               | Input value at the 6th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output value at the 6th point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |
|                                               | Input value at the 7th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output value at the 7th point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |  |                              |                               |

| Specifying interpolation method (Interpolate) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------|---------------|-----|------------------------------------------|-------------------------|-----|------------------------------------------|-------------------------|-----|------------------------------------------|-------------------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|-------------|----------------|------------------------------------------|-------------------------|------------------------------------------|-------------------------|------------------------------------------|-------------------------|------------------------------------------|-------------------------|------------------------------------------|-------------------------|---|---|--------------------------------------------|---------------------------|
| 1: Specifying for each section                | <p>The data that can be read differs depending on Read destination (Target).</p> <p>■When Read destination (Target) is "0: Open area" or "2: Open area (motion service processing)"</p> <p>Sets the top of the section to be read in Offset (Offset), and the Number of sections (NumberOfSections) in Number of read data (Points).</p> <p>The data stored in Read data 1 (Data1) is the PROFILE_CAM_DATA type data when Specifying interpolation method (Interpolate) is "0: Linear interpolation".</p> <p>The data stored in Read data 2 (Data2) is data defined by using target cam data divided equally by the cam resolution points (a pair of current value per cycle and stroke) which is defined in LREAL type two-dimensional array.</p> <p>&lt;Example&gt;</p> <p>Read result of Read data 2 (Data2) when Offset (Offset) is set to "2" and Number of read data (Points) is set to "3" and cam resolution is "256".</p> <p>(When the variable set to Read data 2 (Data2) is a "LREAL[1..8,1..2]" data type "CamData2" label.)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| 2: Spline interpolation                       | <div><div><p>&lt;Variable (label/device)&gt;</p><p>Two-dimensional array label of LREAL type</p><p>(CamData2[1..8,1..2])</p><table><thead><tr><th></th><th>CamData[n][1]</th><th>CamData[n][2]</th></tr></thead><tbody><tr><td>n=1</td><td>Current value per cycle at the 2nd point</td><td>Stroke at the 2nd point</td></tr><tr><td>n=2</td><td>Current value per cycle at the 3rd point</td><td>Stroke at the 3rd point</td></tr><tr><td>n=3</td><td>Current value per cycle at the 4th point</td><td>Stroke at the 4th point</td></tr><tr><td>n=4</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=5</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=6</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=7</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=8</td><td>Not updating</td><td>Not updating</td></tr></tbody></table></div><div><p>Start point</p><p>Initial stroke</p><p>&lt;Open area&gt;</p><table><thead><tr><th>Start point</th><th>Initial stroke</th></tr></thead><tbody><tr><td>Current value per cycle at the 1st point</td><td>Stroke at the 1st point</td></tr><tr><td>Current value per cycle at the 2nd point</td><td>Stroke at the 2nd point</td></tr><tr><td>Current value per cycle at the 3rd point</td><td>Stroke at the 3rd point</td></tr><tr><td>Current value per cycle at the 4th point</td><td>Stroke at the 4th point</td></tr><tr><td>Current value per cycle at the 5th point</td><td>Stroke at the 5th point</td></tr><tr><td>⋮</td><td>⋮</td></tr><tr><td>Current value per cycle at the 256th point</td><td>Stroke at the 256th point</td></tr></tbody></table><p>↑</p><p>Data in which cam data is divided equally by the number of points of cam resolution</p></div><div><p>Offset</p><p>Number of read data (Points)</p></div></div> |                         | CamData[n][1] | CamData[n][2] | n=1 | Current value per cycle at the 2nd point | Stroke at the 2nd point | n=2 | Current value per cycle at the 3rd point | Stroke at the 3rd point | n=3 | Current value per cycle at the 4th point | Stroke at the 4th point | n=4 | Not updating | Not updating | n=5 | Not updating | Not updating | n=6 | Not updating | Not updating | n=7 | Not updating | Not updating | n=8 | Not updating | Not updating | Start point | Initial stroke | Current value per cycle at the 1st point | Stroke at the 1st point | Current value per cycle at the 2nd point | Stroke at the 2nd point | Current value per cycle at the 3rd point | Stroke at the 3rd point | Current value per cycle at the 4th point | Stroke at the 4th point | Current value per cycle at the 5th point | Stroke at the 5th point | ⋮ | ⋮ | Current value per cycle at the 256th point | Stroke at the 256th point |
|                                               | CamData[n][1]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CamData[n][2]           |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=1                                           | Current value per cycle at the 2nd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Stroke at the 2nd point |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=2                                           | Current value per cycle at the 3rd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Stroke at the 3rd point |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=3                                           | Current value per cycle at the 4th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Stroke at the 4th point |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=4                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Not updating            |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=5                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Not updating            |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=6                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Not updating            |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=7                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Not updating            |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=8                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Not updating            |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Start point                                   | Initial stroke                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 1st point      | Stroke at the 1st point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 2nd point      | Stroke at the 2nd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 3rd point      | Stroke at the 3rd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 4th point      | Stroke at the 4th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 5th point      | Stroke at the 5th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| ⋮                                             | ⋮                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 256th point    | Stroke at the 256th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
|                                               | <p>■When Read destination (Target) is "1: File"</p> <p>Sets Offset (Offset) and Number of read data (Points) to "0", and reads all elements. (When a value other than "0" is set, Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs.)</p> <p>The data stored in Read data 1 (Data1) is the PROFILE_CAM_DATA type data when Specifying interpolation method (Interpolate) is "1: Specifying for each section" or "2: Spline interpolation"</p> <p>The data stored in Read data 2 (Data2) is section data defined in PROFILE_CAM_ELEMENT type array.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |             |                |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |

- When the operation profile data format is "rotary cutter"

| Read destination (Target)                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------|---------------|-----|------------------------------------------|-------------------------|-----|------------------------------------------|-------------------------|-----|------------------------------------------|-------------------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|---|---|------------------------------------------|-------------------------|------------------------------------------|-------------------------|------------------------------------------|-------------------------|------------------------------------------|-------------------------|------------------------------------------|-------------------------|---|---|--------------------------------------------|---------------------------|
| 0: Open area                               | <p>Sets the top of the section to be read in Offset (Offset), and the Number of sections (NumberOfSections) in Number of read data (Points). The data stored in Read data 1 (Data1) is the PROFILE_CAM_DATA type data when Specifying interpolation method (Interpolate) is "0: Linear interpolation" and the operation profile data format is "cam data". The data stored in Read data 2 (Data2) is data defined by using target cam data divided equally by the cam resolution points (a pair of current value per cycle and stroke) which is defined in LREAL type two-dimensional array.</p> <p>&lt;Example&gt;<br/>Read result of Read data 2 (Data2) when Offset (Offset) is set to "2" and Number of read data (Points) is set to "3".<br/>(When the variable set to Read data 2 (Data2) is a "LREAL[1..8,1..2]" data type "CamData2" label.)</p> <div><div><p>&lt;Variable (label/device)&gt;<br/>Two-dimensional array label of LREAL type<br/>(CamData2[1..8,1..2])</p><table><thead><tr><th></th><th>CamData[n][1]</th><th>CamData[n][2]</th></tr></thead><tbody><tr><td>n=1</td><td>Current value per cycle at the 2nd point</td><td>Stroke at the 2nd point</td></tr><tr><td>n=2</td><td>Current value per cycle at the 3rd point</td><td>Stroke at the 3rd point</td></tr><tr><td>n=3</td><td>Current value per cycle at the 4th point</td><td>Stroke at the 4th point</td></tr><tr><td>n=4</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=5</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=6</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=7</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=8</td><td>Not updating</td><td>Not updating</td></tr></tbody></table></div><div><p>Start point                      Initial stroke<br/>&lt;Open area&gt;</p><table><thead><tr><th>0</th><th>0</th></tr></thead><tbody><tr><td>Current value per cycle at the 1st point</td><td>Stroke at the 1st point</td></tr><tr><td>Current value per cycle at the 2nd point</td><td>Stroke at the 2nd point</td></tr><tr><td>Current value per cycle at the 3rd point</td><td>Stroke at the 3rd point</td></tr><tr><td>Current value per cycle at the 4th point</td><td>Stroke at the 4th point</td></tr><tr><td>Current value per cycle at the 5th point</td><td>Stroke at the 5th point</td></tr><tr><td>⋮</td><td>⋮</td></tr><tr><td>Current value per cycle at the 255th point</td><td>Stroke at the 255th point</td></tr></tbody></table><p>↑<br/>Data in which cam data is divided equally by the number of points of cam resolution</p></div><div><p>Offset</p><p>Number of read data (Points)</p></div></div> |                         | CamData[n][1] | CamData[n][2] | n=1 | Current value per cycle at the 2nd point | Stroke at the 2nd point | n=2 | Current value per cycle at the 3rd point | Stroke at the 3rd point | n=3 | Current value per cycle at the 4th point | Stroke at the 4th point | n=4 | Not updating | Not updating | n=5 | Not updating | Not updating | n=6 | Not updating | Not updating | n=7 | Not updating | Not updating | n=8 | Not updating | Not updating | 0 | 0 | Current value per cycle at the 1st point | Stroke at the 1st point | Current value per cycle at the 2nd point | Stroke at the 2nd point | Current value per cycle at the 3rd point | Stroke at the 3rd point | Current value per cycle at the 4th point | Stroke at the 4th point | Current value per cycle at the 5th point | Stroke at the 5th point | ⋮ | ⋮ | Current value per cycle at the 255th point | Stroke at the 255th point |
|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | CamData[n][1]           | CamData[n][2] |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=1                                        | Current value per cycle at the 2nd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Stroke at the 2nd point |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=2                                        | Current value per cycle at the 3rd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Stroke at the 3rd point |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=3                                        | Current value per cycle at the 4th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Stroke at the 4th point |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=4                                        | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Not updating            |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=5                                        | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Not updating            |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=6                                        | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Not updating            |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=7                                        | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Not updating            |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| n=8                                        | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Not updating            |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| 0                                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 1st point   | Stroke at the 1st point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 2nd point   | Stroke at the 2nd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 3rd point   | Stroke at the 3rd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 4th point   | Stroke at the 4th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 5th point   | Stroke at the 5th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| ⋮                                          | ⋮                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| Current value per cycle at the 255th point | Stroke at the 255th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| 2: Open area (motion service processing)   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |
| 1: File                                    | <p>Ignores the setting for Offset (Offset) and Number of read data (Points). The data stored in Read data 1 (Data1) is data where the operation profile data format is PROFILE_ROTARY_CUTTER type "rotary cutter". There is no data stored in Read data 2 (Data2).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                         |               |               |     |                                          |                         |     |                                          |                         |     |                                          |                         |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |   |   |                                          |                         |                                          |                         |                                          |                         |                                          |                         |                                          |                         |   |   |                                            |                           |



- When the operation profile data format is "Multiple Axes Positioning Data"

| Read destination (Target)                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                      |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------------------------|-----|-----|-------------------------------|--------------------------------------|-----|-----|------------------------------|-------------------------------------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|-----|------------------------------|-------------------------------------|-----|-------------------------------|--------------------------------------|-----|------------------------------|-------------------------------------|-----|-------------------------------|--------------------------------------|-----|------------------------------|-------------------------------------|-----|------------------------------|-------------------------------------|-----|-----|-----|-----|-----|------------------------------|-------------------------------------|-----|-----|---|---|-----|-----|------------------------------|-------------------------------------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|-----|------------------------------|-------------------------------------|-----|-------------------------------|--------------------------------------|-----|------------------------------|-------------------------------------|-----|----------------------------|--------------------------------------|-----|------------------------------|-------------------------------------|-----|------------------------------|-------------------------------------|-----|-----|-----|-----|
| 0: Open area                             | Specify the top of the section from which positioning data is to be read in Offset (Offset), and the Number of sections (NumberOfSections) in Number of read data (Points).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                      |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| 2: Open area (motion service processing) | <p>Data is read to a PROFILE_POSITIONING_DATA type variable specified in Data1 (TARGET_REF type).</p> <p>When a PROFILE_POSITIONING_DATA_ELEMENT type array variable is specified in Data2 (TARGET_REF type), positioning data is read in the specified variable.</p> <p>Example:</p> <p>Read result of Read data 2 (Data2) when Offset (Offset) is set to "2" and Number of read data (Points) is set to "3".</p> <p>(When the variable set to Read data 2 (Data2) is a "PROFILE_POSITIONING_DATA_ELEMENT[1..8]" data type "PositioningData2" label)</p> <div><div><p>&lt;Variable (label/device)&gt;<br/>PROFILE_POSITIONING_DATA_ELEMENT type label<br/>(PositioningData2[1..8])</p><table><tr><td>n=1</td><td>DataNo(3) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td>n=2</td><td>DataNo(4) of the fourth point</td><td>OperationPattern of the fourth point</td><td>...</td></tr><tr><td>n=3</td><td>DataNo(5) of the fifth point</td><td>OperationPattern of the fifth point</td><td>...</td></tr><tr><td>n=4</td><td>(Not updating)</td><td>(Not updating)</td><td>...</td></tr><tr><td>n=5</td><td>(Not updating)</td><td>(Not updating)</td><td>...</td></tr><tr><td>n=6</td><td>(Not updating)</td><td>(Not updating)</td><td>...</td></tr><tr><td>n=7</td><td>(Not updating)</td><td>(Not updating)</td><td>...</td></tr><tr><td>n=8</td><td>(Not updating)</td><td>(Not updating)</td><td>...</td></tr></table></div><div><p>&lt;Open area&gt;</p><table><tr><td>DataNo(1) of the first point</td><td>OperationPattern of the first point</td><td>...</td></tr><tr><td>DataNo(2) of the second point</td><td>OperationPattern of the second point</td><td>...</td></tr><tr><td>DataNo(3) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td>DataNo(4) of the fourth point</td><td>OperationPattern of the fourth point</td><td>...</td></tr><tr><td>DataNo(5) of the fifth point</td><td>OperationPattern of the fifth point</td><td>...</td></tr><tr><td>DataNo(6) of the sixth point</td><td>OperationPattern of the sixth point</td><td>...</td></tr><tr><td>...</td><td>...</td><td>...</td></tr></table></div><div><p>Offset (Offset)</p><p>Number of read data (Points)</p></div></div> <p>When positioning data that has not been set for open or write is present in the read target section, the initial value is stored in the section data with the corresponding DataNo. (DataNo will be 0.)</p> <p>Example:</p> <p>When the fourth open area (positioning data number 4) in the above example has not been set for open or write</p> <div><div><p>&lt;Variable (label/device)&gt;<br/>PROFILE_POSITIONING_DATA_ELEMENT type label<br/>(PositioningData2[1..8])</p><table><tr><td>n=1</td><td>DataNo(3) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td>n=2</td><td>0</td><td>0</td><td>...</td></tr><tr><td>n=3</td><td>DataNo(5) of the fifth point</td><td>OperationPattern of the fifth point</td><td>...</td></tr><tr><td>n=4</td><td>(Not updating)</td><td>(Not updating)</td><td>...</td></tr><tr><td>n=5</td><td>(Not updating)</td><td>(Not updating)</td><td>...</td></tr><tr><td>n=6</td><td>(Not updating)</td><td>(Not updating)</td><td>...</td></tr><tr><td>n=7</td><td>(Not updating)</td><td>(Not updating)</td><td>...</td></tr><tr><td>n=8</td><td>(Not updating)</td><td>(Not updating)</td><td>...</td></tr></table></div><div><p>&lt;Open area&gt;</p><table><tr><td>DataNo(1) of the first point</td><td>OperationPattern of the first point</td><td>...</td></tr><tr><td>DataNo(2) of the second point</td><td>OperationPattern of the second point</td><td>...</td></tr><tr><td>DataNo(3) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td>DataNo of the fourth point</td><td>OperationPattern of the fourth point</td><td>...</td></tr><tr><td>DataNo(5) of the fifth point</td><td>OperationPattern of the fifth point</td><td>...</td></tr><tr><td>DataNo(6) of the sixth point</td><td>OperationPattern of the sixth point</td><td>...</td></tr><tr><td>...</td><td>...</td><td>...</td></tr></table></div><div><p>Offset (Offset)</p><p>Number of read data (Points)</p></div></div> <p>When a PROFILE_POSITIONING_DATA_EXTENDED type variable is specified in Data2 (TARGET_REF type)</p> <p>The condition signal, skip signal, and positioning data are stored in their corresponding variables specified as the WSTRING type in variable members ConditionSignal, SkipSignal, and PositioningData.</p> <p>For the condition signal and skip signal, PROFILE_SIGNAL_SELECT_ELEMENT type array data is read. For positioning data, PROFILE_POSITIONING_DATA_ELEMENT type array data is read. (This behavior is the same as specifying a PROFILE_POSITIONING_DATA_ELEMENT type array as Data2 (TARGET_REF type).)</p> | n=1                                  | DataNo(3) of the third point | OperationPattern of the third point | ... | n=2 | DataNo(4) of the fourth point | OperationPattern of the fourth point | ... | n=3 | DataNo(5) of the fifth point | OperationPattern of the fifth point | ... | n=4 | (Not updating) | (Not updating) | ... | n=5 | (Not updating) | (Not updating) | ... | n=6 | (Not updating) | (Not updating) | ... | n=7 | (Not updating) | (Not updating) | ... | n=8 | (Not updating) | (Not updating) | ... | DataNo(1) of the first point | OperationPattern of the first point | ... | DataNo(2) of the second point | OperationPattern of the second point | ... | DataNo(3) of the third point | OperationPattern of the third point | ... | DataNo(4) of the fourth point | OperationPattern of the fourth point | ... | DataNo(5) of the fifth point | OperationPattern of the fifth point | ... | DataNo(6) of the sixth point | OperationPattern of the sixth point | ... | ... | ... | ... | n=1 | DataNo(3) of the third point | OperationPattern of the third point | ... | n=2 | 0 | 0 | ... | n=3 | DataNo(5) of the fifth point | OperationPattern of the fifth point | ... | n=4 | (Not updating) | (Not updating) | ... | n=5 | (Not updating) | (Not updating) | ... | n=6 | (Not updating) | (Not updating) | ... | n=7 | (Not updating) | (Not updating) | ... | n=8 | (Not updating) | (Not updating) | ... | DataNo(1) of the first point | OperationPattern of the first point | ... | DataNo(2) of the second point | OperationPattern of the second point | ... | DataNo(3) of the third point | OperationPattern of the third point | ... | DataNo of the fourth point | OperationPattern of the fourth point | ... | DataNo(5) of the fifth point | OperationPattern of the fifth point | ... | DataNo(6) of the sixth point | OperationPattern of the sixth point | ... | ... | ... | ... |
| n=1                                      | DataNo(3) of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | OperationPattern of the third point  | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=2                                      | DataNo(4) of the fourth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | OperationPattern of the fourth point | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=3                                      | DataNo(5) of the fifth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | OperationPattern of the fifth point  | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=4                                      | (Not updating)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (Not updating)                       | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=5                                      | (Not updating)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (Not updating)                       | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=6                                      | (Not updating)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (Not updating)                       | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=7                                      | (Not updating)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (Not updating)                       | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=8                                      | (Not updating)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (Not updating)                       | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(1) of the first point             | OperationPattern of the first point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(2) of the second point            | OperationPattern of the second point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(3) of the third point             | OperationPattern of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(4) of the fourth point            | OperationPattern of the fourth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(5) of the fifth point             | OperationPattern of the fifth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(6) of the sixth point             | OperationPattern of the sixth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| ...                                      | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=1                                      | DataNo(3) of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | OperationPattern of the third point  | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=2                                      | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0                                    | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=3                                      | DataNo(5) of the fifth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | OperationPattern of the fifth point  | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=4                                      | (Not updating)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (Not updating)                       | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=5                                      | (Not updating)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (Not updating)                       | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=6                                      | (Not updating)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (Not updating)                       | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=7                                      | (Not updating)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (Not updating)                       | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| n=8                                      | (Not updating)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (Not updating)                       | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(1) of the first point             | OperationPattern of the first point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(2) of the second point            | OperationPattern of the second point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(3) of the third point             | OperationPattern of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo of the fourth point               | OperationPattern of the fourth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(5) of the fifth point             | OperationPattern of the fifth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(6) of the sixth point             | OperationPattern of the sixth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |
| ...                                      | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |   |   |     |     |                              |                                     |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |     |                |                |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                            |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |

| Read destination<br>(Target)    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                      |     |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----|---|-----|-----|------------------------------|-------------------------------------|-----|-----|-------------------------------|--------------------------------------|-----|-----|---|---|-----|-----|------------------------------|-------------------------------------|-----|--|-----|-----|-----|-------|---------------------------------|--------------------------------------|-----|------------------------------|-------------------------------------|-----|-------------------------------|--------------------------------------|-----|------------------------------|-------------------------------------|-----|---------------------------------|--------------------------------------|-----|
| 1: File                         | <p>Specify Offset (Offset) and Number of read data (Points) to 0 to read all elements.<br/>(When a value other than 0 is set, Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs.)<br/>Data is read to a PROFILE_POSITIONING_DATA type variable specified in Data1 (TARGET_REF type).<br/>When a PROFILE_POSITIONING_DATA_ELEMENT type array variable is specified in Data2 (TARGET_REF type), positioning data is read in the specified variable.</p> <p>When an empty DataNo is prepared in the file and positioning data is set, the initial value is stored in the section data corresponding to the empty DataNo. (DataNo will be 0.)</p> <p>Example:<br/>Read result of Read data 2 (Data2) when Offset (Offset) is set to "0" and Number of read data (Points) is set to "0"<br/>(When the variable set to Read data 2 (Data2) is a "PROFILE_POSITIONING_DATA_ELEMENT[1..100]" data type "PositioningData2" label)</p> <div><div><p style="text-align: center;">&lt;Variable (label/device)&gt;<br/>PROFILE_POSITIONING_DATA_ELEMENT type label<br/>(PositioningData2[1..100])</p><table><tr><td>n=1</td><td>0</td><td>0</td><td>...</td></tr><tr><td>n=2</td><td>DataNo(2) of the first point</td><td>OperationPattern of the first point</td><td>...</td></tr><tr><td>n=3</td><td>DataNo(3) of the second point</td><td>OperationPattern of the second point</td><td>...</td></tr><tr><td>n=4</td><td>0</td><td>0</td><td>...</td></tr><tr><td>n=5</td><td>DataNo(5) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td></td><td>...</td><td>...</td><td>...</td></tr><tr><td>n=100</td><td>DataNo(100) of the fourth point</td><td>OperationPattern of the fourth point</td><td>...</td></tr></table></div><div><p style="text-align: center;">&lt;File&gt;</p><table><tr><td>DataNo(2) of the first point</td><td>OperationPattern of the first point</td><td>...</td></tr><tr><td>DataNo(3) of the second point</td><td>OperationPattern of the second point</td><td>...</td></tr><tr><td>DataNo(5) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td>DataNo(100) of the fourth point</td><td>OperationPattern of the fourth point</td><td>...</td></tr></table></div></div> <p>When a PROFILE_POSITIONING_DATA_EXTENDED type variable is specified in Data2 (TARGET_REF type)<br/>The condition signal, skip signal, and positioning data are stored in their corresponding variables specified as the WSTRING type in variable members ConditionSignal, SkipSignal, and PositioningData.<br/>For the condition signal and skip signal, PROFILE_SIGNAL_SELECT_ELEMENT type array data is read.<br/>For positioning data, PROFILE_POSITIONING_DATA_ELEMENT type array data is read. (This behavior is the same as specifying a PROFILE_POSITIONING_DATA_ELEMENT type array variable as Data2 (TARGET_REF type).)</p> | n=1                                  | 0   | 0 | ... | n=2 | DataNo(2) of the first point | OperationPattern of the first point | ... | n=3 | DataNo(3) of the second point | OperationPattern of the second point | ... | n=4 | 0 | 0 | ... | n=5 | DataNo(5) of the third point | OperationPattern of the third point | ... |  | ... | ... | ... | n=100 | DataNo(100) of the fourth point | OperationPattern of the fourth point | ... | DataNo(2) of the first point | OperationPattern of the first point | ... | DataNo(3) of the second point | OperationPattern of the second point | ... | DataNo(5) of the third point | OperationPattern of the third point | ... | DataNo(100) of the fourth point | OperationPattern of the fourth point | ... |
| n=1                             | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0                                    | ... |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=2                             | DataNo(2) of the first point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | OperationPattern of the first point  | ... |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=3                             | DataNo(3) of the second point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | OperationPattern of the second point | ... |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=4                             | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0                                    | ... |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=5                             | DataNo(5) of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | OperationPattern of the third point  | ... |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
|                                 | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ...                                  | ... |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=100                           | DataNo(100) of the fourth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | OperationPattern of the fourth point | ... |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| DataNo(2) of the first point    | OperationPattern of the first point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ...                                  |     |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| DataNo(3) of the second point   | OperationPattern of the second point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ...                                  |     |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| DataNo(5) of the third point    | OperationPattern of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ...                                  |     |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| DataNo(100) of the fourth point | OperationPattern of the fourth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ...                                  |     |   |     |     |                              |                                     |     |     |                               |                                      |     |     |   |   |     |     |                              |                                     |     |  |     |     |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |

- When the operation profile data format is "Digital Cam Switch Data"

| Read destination (Target)                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Open area                             | <p>The top of the section to be read in Offset (Offset) and the Number of sections (NumberOfSections) in Number of read data (Points) are set.</p> <p>The data stored in Read data 1 (Data1) is the PROFILE_CAMSWITCH_DATA type data.</p> <p>The data stored in Read data 2 (Data2) is the data for which the data of the specified switch settings (FirstOnPosition, LastOnPosition, Direction, CamSwitchMode, and Duration) is defined as the PROFILE_CAMSWITCH_ELEMENT type array.</p> <p>Example:</p> <p>Read result of Read data 2 (Data2) when Offset (Offset) is set to "2" and Number of read data (Points) is set to "3".</p> <p>(When the variable set to Read data 2 (Data2) is a "PROFILE_CAMSWITCH_ELEMENT[1..8]" data type "DigitalCamSwitch Data2" label)</p> <div style="text-align: center;"> <p>&lt;Variable (label/device)&gt;<br/>PROFILE_CAMSWITCH_ELEMENT type label<br/>(PositioningData2[1..8])</p> </div> |
| 2: Open area (motion service processing) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 1: File                                  | <p>Specify Offset (Offset) and Number of read data (Points) to 0 to read all elements.</p> <p>(When a value other than 0 is set, Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs.)</p> <p>The data stored in Read data 1 (Data1) is the PROFILE_CAMSWITCH_DATA type data.</p> <p>The data stored in Read data 2 (Data2) is the data for which the data of the specified switch settings (FirstOnPosition, LastOnPosition, Direction, CamSwitchMode, and Duration) is defined as the PROFILE_CAMSWITCH_ELEMENT type array.</p>                                                                                                                                                                                                                                                                                                                                                                                |

## ■Read data 1 (Data1)/Read data 2 (Data2)

Set read data of the operation profile data with a TARGET\_REF structure. The [VAR] and [DEV] data types can be used. For details on the TARGET\_REF structure, refer to the following.

📖 Page 1489 TARGET\_REF (Input signal)

For data types, read data structures of each operation profile data format can be used.

- Read data 1 (Data1) The operation profile data formats and data types set in Read data 1 (Data1) are shown below.

| Operation profile data format | Data type             | Reference                       |
|-------------------------------|-----------------------|---------------------------------|
| Cam data                      | PROFILE_CAM_DATA      | Page 1494 PROFILE_CAM_DATA      |
| Cam data for rotary cutter    | PROFILE_ROTARY_CUTTER | Page 1496 PROFILE_ROTARY_CUTTER |

### Ex.

When reading by using a device or label

- When reading a PROFILE\_CAM\_DATA type label (CamData1)

Data1.Target := "[VAR]CamData1"

- Read data 2 (Data2) The operation profile data formats and data types set in Read data 2 (Data2) are shown below. The data type of the structure that is set varies depending on Read destination (Target) and Specifying interpolation method (Interpolate) of the target cam data.

If the number of elements of the specified array is less than (the resolution + 1/number of coordinates) when the entire operation profile data is read, Number of Read/Write Data Mismatch (error code: 1BACH) occurs.

○: Supported, ×: Not supported

| Operation profile data format | Read destination (Target)                                  | Data type                           | Specifying interpolation method (Interpolate) |                                |                         | Reference                     |
|-------------------------------|------------------------------------------------------------|-------------------------------------|-----------------------------------------------|--------------------------------|-------------------------|-------------------------------|
|                               |                                                            |                                     | 0: Linear interpolation                       | 1: Specifying for each section | 2: Spline interpolation |                               |
| Cam data                      | 2: Open area (motion service processing)                   | LREAL[] <sup>*1</sup>               | ○                                             | ○ <sup>*3</sup>                | ○ <sup>*3</sup>         | —                             |
|                               | 1: File                                                    | LREAL[] <sup>*1</sup>               | ○                                             | ×                              | ×                       | —                             |
|                               |                                                            | PROFILE_CAM_ELEMENT[] <sup>*2</sup> | ×                                             | ○                              | ○ <sup>*4</sup>         | Page 1495 PROFILE_CAM_ELEMENT |
| Cam data for rotary cutter    | Setting is unnecessary.<br>If set, the setting is ignored. |                                     |                                               |                                |                         | —                             |

- \*1 The LREAL type two-dimensional array is set as follows.

LREAL[m..n,o..p]

| Item                         | Description                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of elements (n-m+1)   | Sets the array elements so that they are greater than the number of points that are to be read.<br>When reading the entire operation profile data (Offset (Offset), Number of read data (Points) are set to "0"), set this to the cam data resolution + 1/the number of coordinates or more.<br>However, an area bigger than the resolution + 1/number of coordinates in Read data 1 (Data1) will not be updated. |
| Number of dimensions (p-o+1) | The stroke and current position per cycle for each point are read.<br>Set the array element to "2".<br>If the array element is set to "3" or more, a read is possible, but as the intended result of the read may not be obtained due to data being moved forward, make sure to set the array element to "2".                                                                                                     |

- \*2 The PROFILE\_CAM\_ELEMENT array is set as follows.

PROFILE\_CAM\_ELEMENT[m..n]

| Item                       | Description                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of elements (n-m+1) | Sets the array elements so that they are greater than the number of points that are to be read.<br>When reading the entire operation profile data (Offset (Offset), Number of read data (Points) are set to "0"), set this to the cam data Number of sections (NumberOfSections) or more.<br>However, an area bigger than the Number of sections (NumberOfSections) in Read data 1 (Data1) will not be updated. |

- \*3 Reads as stroke data (a pair of current value per cycle and stroke) opened to the open area. X of 1st point data is the value set in start point, and Y of 1st point data is the value set in initial stroke amount.

Data after the 2nd point is stroke data divided by the resolution. Due to this, the read points in the open area is "resolution+1".

- \*4 Only used by the end point and stroke.

**Ex.**

When setting LREAL type with Specifying interpolation method (Interpolate)

| Specifying interpolation method (Interpolate) | Setting example                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Linear interpolation                       | <p>The following shows examples of setting the two-dimensional label coordinate number "100" to Target (Target) of the TARGET_REF structure.</p> <p>Data2.Target := "[VAR]CamData2"</p> <ul style="list-style-type: none"> <li>* CamData2 declares the "LREAL[1..100,1..2]" label to data type and label name of the global label to "CamData2", and specifies the character string for Target (Target). The read data is as shown below. <ul style="list-style-type: none"> <li>· CamData2[n,1]: nth point current position per cycle</li> <li>· CamData2[n,2]: nth point stroke</li> </ul> </li> </ul> |
| 1: Section interpolation                      | <p>The following shows examples of setting the two-dimensional label resolution "100" to Target (Target) of the TARGET_REF structure.</p> <p>TARGET_REF.Target := "[VAR]CamData2"</p>                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 2: Spline interpolation                       | <ul style="list-style-type: none"> <li>* CamData2 declares the "LREAL[1..101,1..2]" label to data type and label name of the global label to "CamData2", and specifies the character string for Target (Target). The read data is as shown below. <ul style="list-style-type: none"> <li>· CamData2[1,1]: Value set for the start point</li> <li>· CamData2[1,2]: Value set for the initial stroke amount</li> <li>· CamData2[n+1,1]: nth point current position per cycle</li> <li>· CamData2[n+1,2]: nth point stroke</li> </ul> </li> </ul>                                                           |

**Ex.**

For PROFILE\_CAM\_ELEMENT type

| Setting example                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The following shows examples of setting the two-dimensional label number of sections "10" to Target (Target) of the TARGET_REF structure.</p> <p>Data2.Target := "[VAR]CamData2"</p> <ul style="list-style-type: none"> <li>* CamData2 declares the "PROFILE_CAM_ELEMENT[1..10]" label to data type and label name of the global label to "CamData2", and specifies the character string for Target (Target). The read data is as shown below. <ul style="list-style-type: none"> <li>· CamData2[n]: nth point section data (PROFILE_CAM_ELEMENT type)</li> </ul> </li> </ul> |

**Point** 

- If the type of the specified data structure for reading does not match the type that is required for each operation profile data, Read/Write Data Type Incorrect (error code: 1BAAH) occurs.
- For details on the cam data for the operation profile data set in Read data 1 (Data1)/Read data 2 (Data2), refer to the following.

 User's manual for the controller used

## ■Read destination (Target)

Sets the read destination of the operation profile data.

| Setting value                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Open area                             | <ul style="list-style-type: none"><li>• The Profile ID (ID) value of the PROFILE_DATA structure is referred to, and the read is performed for the operation profile data that Profile ID No. (Number) of the PROFILE_ID structure indicates in the open area.</li><li>• The read is performed at the cycle of the executed program.</li><li>• If the operation profile data does not exist (unopened), No Operation Profile Data (error code: 1B8EH) occurs.</li></ul>       |
| 1: File                                  | <ul style="list-style-type: none"><li>• The Operation profile data storage location (Location) value of the PROFILE_DATA structure is referred, and the read is performed for the operation profile data that the file name and the path indicate.</li><li>• The read is performed at the cycle of the motion service processing.</li><li>• If the operation profile data does not exist, No Operation Profile Data (error code: 1B8EH) occurs.</li></ul>                    |
| 2: Open area (motion service processing) | <ul style="list-style-type: none"><li>• The Profile ID (ID) value of the PROFILE_DATA structure is referred, and the read is performed for the operation profile data that Profile ID No. (Number) of the PROFILE_ID structure indicates in the open area.</li><li>• The read is performed at the cycle of the motion service processing.</li><li>• If the operation profile data does not exist (unopened), No Operation Profile Data (error code: 1B8EH) occurs.</li></ul> |

### Point

- When Read destination (Target) is "1: File" or "2: Open area (motion service processing)", as motion service processing is used in that case, it may take much time for the processing to complete. Use Done (Execution completion) for the interlock as needed.
- When Target is set to "0: Open area", the processing is completed immediately as it is performed within the task where the FB is called. The program execution time increases when the number of write data points is too large. Therefore, execute the write multiple times with smaller data quantities as needed, or use the setting with Target set to "2: Open area (motion service processing)".

## Precautions

The number of data points that can be read at the same time are limited. If the read is not completed in a single FB execution, execute the read over several FB executions.

## Program example

The following is a program example. "LREAL type (two-dimensional array) format" cam data 1 (ProfileData0001) and "PROFILE\_CAM\_ELEMENT format" cam data 2 (ProfileData0002) are read from the file.

### ■ Operation profile data

| Profile ID | Label name      | Data type  | Comment    |
|------------|-----------------|------------|------------|
| 1          | ProfileData0001 | MC_CAM_REF | Cam data 1 |
| 2          | ProfileData0002 | MC_CAM_REF | Cam data 2 |

#### • Operation profile data (cam data) settings

| Item                            |                  | ProfileData0001      | ProfileData0002             |
|---------------------------------|------------------|----------------------|-----------------------------|
| Specifying interpolation method |                  | Linear interpolation | Specifying for each section |
| Resolution                      |                  | —                    | 256                         |
| Length per cycle setting        | Unit             | degree               | degree                      |
|                                 | Length per cycle | 360.00000            | 360.00000                   |
| Stroke amount                   | Unit             | pulse                | %                           |
|                                 | Stroke amount    | 100.0                | 100.0000000                 |
| Cam 1 cycle time                |                  | —                    | 1.000[s]                    |
| Initial stroke value            |                  | —                    | 0.0000000                   |
| Cam 1 stroke minimum value      |                  | 0.00000              | —                           |
| Cam 1 stroke maximum value      |                  | 360.00000            | —                           |

#### • ProfileData0001

| Section No. | Input value [degree] | Output value [pulse] |
|-------------|----------------------|----------------------|
| 1           | 0.00000              | 0.0                  |
| 2           | 90.00000             | 60.0                 |
| 3           | 180.00000            | 100.0                |
| 4           | 270.00000            | 30.0                 |
| 5           | 360.00000            | 0.0                  |

#### • ProfileData0002

| Section No. | Start point [degree] | End point [degree] | Stroke [%]  | Cam curve type    |
|-------------|----------------------|--------------------|-------------|-------------------|
| 1           | 0.00000              | 90.00000           | 60.0000000  | Single hypotenuse |
| 2           | 90.00000             | 180.00000          | 100.0000000 | Single hypotenuse |
| 3           | 180.00000            | 270.00000          | 30.0000000  | Single hypotenuse |
| 4           | 270.00000            | 0.00000            | 0.0000000   | Single hypotenuse |

## ■Labels used

| Label name                        | Data type                               | Comment                                                   |
|-----------------------------------|-----------------------------------------|-----------------------------------------------------------|
| MCv_ReadProfileData_1             | MCv_ReadProfileData                     | Profile Read FB 1                                         |
| ReadData1_1                       | TARGET_REF                              | Read data 1 Profile 1                                     |
| ReadData2_1                       | TARGET_REF                              | Read data 2 Profile 1                                     |
| ReadData1_Lreal                   | PROFILE_CAM_DATA                        | Profile data Cam data 1                                   |
| ReadData2_Lreal                   | Double-precision real number(0..4,0..1) | Input value/Output value data LREAL type                  |
| bReadProfile1                     | Bit                                     | Profile read command 1                                    |
| bDone1                            | Bit                                     | Completion 1                                              |
| bBusy1                            | Bit                                     | Executing 1                                               |
| bError1                           | Bit                                     | Error 1                                                   |
| uwErrorID1                        | Word [unsigned]/bit string [16-bit]     | Error code 1                                              |
| Cam_ProfileData0001 <sup>*1</sup> | PROFILE_DATA                            | Profile data 0001                                         |
| MCv_ReadProfileData_2             | MCv_ReadProfileData                     | Profile Read FB 2                                         |
| ReadData1_2                       | TARGET_REF                              | Read data 1 Profile 2                                     |
| ReadData2_2                       | TARGET_REF                              | Read data 2 Profile 2                                     |
| ReadData1_Element                 | PROFILE_CAM_DATA                        | Profile data Cam data 2                                   |
| ReadData2_Element                 | PROFILE_CAM_ELEMENT(0..3)               | Input value/Output value data<br>PROFILE_CAM_ELEMENT type |
| bReadProfile2                     | Bit                                     | Profile read command 2                                    |
| bDone2                            | Bit                                     | Completion 2                                              |
| bBusy2                            | Bit                                     | Executing 2                                               |
| bError2                           | Bit                                     | Error 2                                                   |
| uwErrorID2                        | Word [unsigned]/bit string [16-bit]     | Error code 2                                              |
| Cam_ProfileData0002 <sup>*1</sup> | PROFILE_DATA                            | Profile data 0002                                         |

\*1 Only used in FBD/LD programs. (Required to use the operation profile data in FBD/LD programs.)

## ■Global labels used

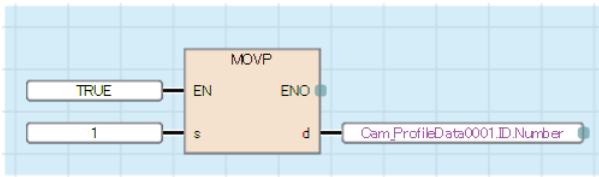
| Label name                        | Data type           | Comment             |
|-----------------------------------|---------------------|---------------------|
| G_ProfileCamData <sup>*1</sup>    | PROFILE_CAM_DATA    | Profile cam data    |
| G_ProfileCamELEMENT <sup>*1</sup> | PROFILE_CAM_ELEMENT | Profile cam element |

\*1 Only used in FBD/LD programs. (Required to use the operation profile data in FBD/LD programs.)

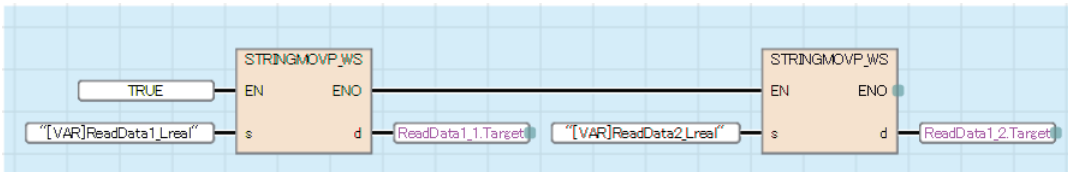


## ■ FBD/LD program

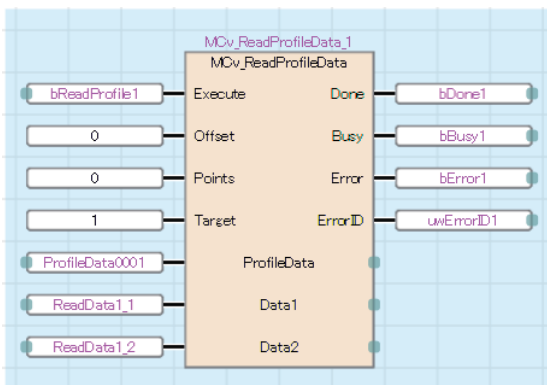
- Profile data 0001



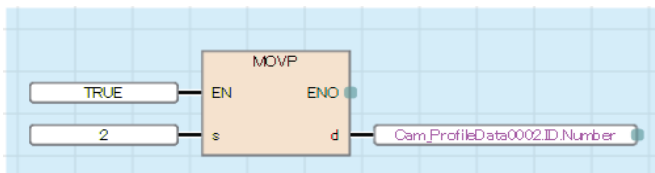
- Read data 1



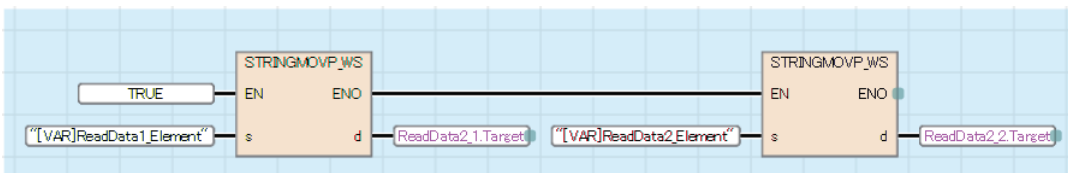
- Profile Read 1 (reads cam data in the LREAL type (two-dimensional array) format)



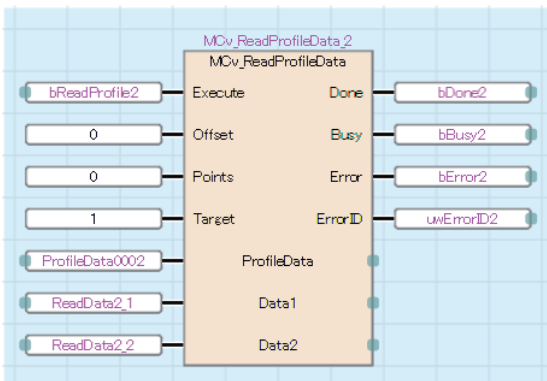
- Profile data 0002



- Read data 2



- Profile Read 2 (reads cam data in the PROFILE\_CAM\_ELEMENT type format)



## ■ST program

```
//-----Read data 1-----
ReadData1_1.Target := "[VAR]ReadData1_Lreal";
ReadData2_1.Target := "[VAR]ReadData2_Lreal";

//-----Profile Read 1-----
//-----Reads cam data in the LREAL type (two-dimensional array) format-----
MCv_ReadProfileData_1(
  ProfileData:= ProfileData0001.ProfileData ,
  Data1:= ReadData1_1 ,
  Data2:= ReadData2_1 ,
  Execute:= bReadProfile1 ,
  Offset:= 0 ,
  Points:= 0 ,
  Target:= 1 ,
  Done=> bDone1 ,
  Busy=> bBusy1 ,
  Error=> bError1 ,
  ErrorID=> uwErrorID1
);

//-----Read Data 2-----
ReadData1_2.Target := "[VAR]ReadData1_Element";
ReadData2_2.Target := "[VAR]ReadData2_Element";

//-----Profile Read 2-----
//-----Reads cam data in the PROFILE_CAM_ELEMENT type format-----
MCv_ReadProfileData_2(
  ProfileData:= ProfileData0002.ProfileData ,
  Data1:= ReadData1_2 ,
  Data2:= ReadData2_2 ,
  Execute:= bReadProfile2 ,
  Offset:= 0 ,
  Points:= 0 ,
  Target:= 1 ,
  Done=> bDone2 ,
  Busy=> bBusy2 ,
  Error=> bError2 ,
  ErrorID=> uwErrorID2
);
```

## 47.2 Profile Write

47

### MCv\_WriteProfileData

This FB writes the specified operation profile data to the open area or a file.

| Ladder | FBD/LD | ST                                                                                                                                                                                                                                                                                                                                                          |
|--------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |        | <pre> MCv_WriteProfileData(   ProfileData:= ?PROFILE_DATA? ,   Data1:= ?TARGET_REF? ,   Data2:= ?TARGET_REF? ,   Execute:= ?BOOL? ,   Offset:= ?DWORD? ,   Points:= ?DWORD? ,   Target:= ?WORD? ,   ExecutionMode:= ?INT? ,   Done=&gt; ?BOOL? ,   Busy=&gt; ?BOOL? ,   Error=&gt; ?BOOL? ,   ErrorID=&gt; ?WORD? ,   ProfileID=&gt; ?PROFILE_ID? ); </pre> |

### Setting data

#### I/O variables

| I/O variable | Name         | Data type    | Input    | Setting range | Default value         | Description                                                                                                                                                                                                                                                                                             |
|--------------|--------------|--------------|----------|---------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ProfileData  | Profile data | PROFILE_DATA | At start | —             | Omission not possible | The operation profile data to be written is set.<br>The operation profile data is set with a PROFILE_DATA structure. For the PROFILE_DATA structure, refer to the following.<br>Page 1492 PROFILE_DATA<br>The operation profile data in which the write data structure has been defined can be written. |
| Data1        | Write data 1 | TARGET_REF   | At start | —             | Omission not possible | The write data structure suitable for the operation profile data format to be written is set.<br>For details, refer to the following.<br>Page 1976 Write data 1 (Data1)/Write data 2 (Data2)                                                                                                            |
| Data2        | Write data 2 | TARGET_REF   | At start | —             | Omission not possible | The write data structure suitable for the operation profile data format to be written is set.<br>For details, refer to the following.<br>Page 1976 Write data 1 (Data1)/Write data 2 (Data2)                                                                                                            |

## ■Input variables

| Input variable | Name                 | Data type                  | Input    | Setting range                   | Default value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------|----------------------|----------------------------|----------|---------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Execute        | Start                | BOOL                       | At start | TRUE, FALSE                     | FALSE         | When this variable is set to TRUE, MCv_WriteProfileData (Profile Write) is executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Offset         | Offset               | DWORD(UDINT)               | At start | 0 to resolution<br>(2 to 65535) | 0             | <p>The offset from the start of the operation profile data is set.</p> <p>If Offset (Offset) exceeds the range of the operation profile data, Out of Offset Range (error code: 1B92H) occurs and the data will not be written.</p> <p>When a value other than "0" is set, set a value other than "0" to Number of write data (Points). (If "0" is set to Number of write data (Points), Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs.)</p> <p>* The write operation differs depending on the values set to Offset (Offset) and Number of write data (Points). For details, refer to the following.</p> <p> Page 1972 Offset (Offset) and Number of write data (Points) setting</p> |
| Points         | Number of write data | DWORD(UDINT)               | At start | 0 to 4294967295                 | 0             | <p>The number of write data points is set.</p> <p>When Number of write data (Points) exceeds the number of elements in the operation profile data, the operation profile data for the number of elements is written.</p> <p>When "1: File" is set to Write destination (Target), set "0". (When a value other than "0" is set, Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs.)</p>                                                                                                                                                                                                                                                                                                                                                                                    |
| Target         | Write destination    | WORD(UINT)                 | At start | 0, 1, 2                         | 0             | <p>The write destination of the operation profile data is set.</p> <ul style="list-style-type: none"> <li>• 0: Open area</li> <li>• 1: File</li> <li>• 2: Open area (motion service processing)</li> </ul> <p>* When "1: File" is set for Write destination (Target), set "0" to Offset (Offset) and Number of write data (Points). (When a value other than "0" is set, Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs.)</p> <p>For details, refer to the following.</p> <p> Page 1978 Write destination (Target)</p>                                                                                                                                                             |
| ExecutionMode  | Execution mode       | INT<br>(MC_EXECUTION_MODE) | At start | 0, 1, 3                         | 0             | <p>The execution timing of MCv_WriteProfileData (Profile Write) is set.</p> <ul style="list-style-type: none"> <li>• 0: Execute immediately (mcImmediately)</li> <li>• 1: Execute at completion (mcQueued)</li> <li>• 3: Execute speculatively (mcSpeculatively)</li> </ul> <p>For details, refer to the following.</p> <p> Page 1979 Execution mode (ExecutionMode)</p>                                                                                                                                                                                                                                                                                                                                  |

## ■Output variables

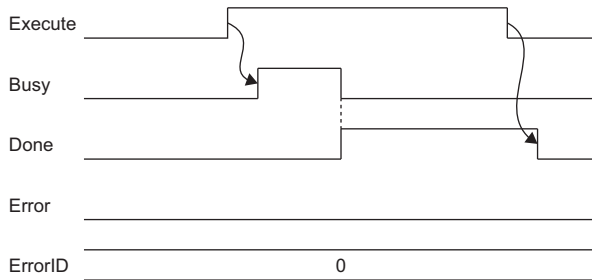
| Output variable | Name       | Data type  | Default value | Description                                                                                                                                                                                                                                                                                                                                                             |
|-----------------|------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Done            | Completion | BOOL       | FALSE         | <p>This variable becomes TRUE when the control is completed.</p> <p>The value differs depending on the status of Start (Execute) at operation completion.</p> <p>■When Start (Execute) is TRUE</p> <p>This variable remains TRUE until Start (Execute) is set to FALSE.</p> <p>■When Start (Execute) is FALSE</p> <p>This variable becomes TRUE only for one cycle.</p> |
| Busy            | Executing  | BOOL       | FALSE         | This variable becomes TRUE when MCv_WriteProfileData (Profile Write) is executed.                                                                                                                                                                                                                                                                                       |
| Error           | Error      | BOOL       | FALSE         | This variable becomes TRUE when an error occurs.                                                                                                                                                                                                                                                                                                                        |
| ErrorID         | Error code | WORD(UINT) | 0             | <p>When an error occurs, this variable returns the error code.</p> <p>For details on error codes, refer to the following.</p> <p> User's manual for the controller used</p>                                                                                                          |
| ProfileID       | Profile ID | PROFILE_ID | 0             | The profile ID is output.                                                                                                                                                                                                                                                                                                                                               |

## Processing details

- This FB writes the operation profile data.
- The file specified in Profile data (ProfileData) and Write destination (Target), or the operation profile data in the open area are written for the number of points specified in Number of write data (Points) from the data specified with Offset (Offset).
- To write the whole operation profile data, specify "0" in both Offset (Offset) and Number of write data (Points).
- Write data is stored in variables specified in Write data 1 (Data1) and Write data 2 (Data2).

### ■Timing chart

- When the processing is completed successfully



- When the processing is completed with an error

For the timing chart, refer to the following.

👉 Page 1432 Basic operation of Execution command (Execute) type motion control FBs

## ■Offset (Offset) and Number of write data (Points) setting

The following operations are based on the values set in Offset (Offset) and Number of write data (Points).

The contents of the values set for Offset (Offset) and Number of write data (Points) vary depending on the operation profile data format.

The following describes the contents when "cam data" and "rotary cutter" are set to the operation profile data format.

- When the operation profile data format is "cam data"

| Specifying interpolation method (Interpolate) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                               |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------|---------------|-----|------------------------------|-------------------------------|-----|------------------------------|-------------------------------|-----|------------------------------|-------------------------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|-----|--------------|--------------|--|-------------|--------------|--|------------------|------------------|--|------------------|------------------|--|------------------|------------------|--|------------------|------------------|--|------------------|------------------|--|------------------|------------------|--|------------------|------------------|--|------------------|------------------|
| 0: Linear interpolation                       | <p>Sets the top of the coordinate for write in Offset (Offset), and the number of coordinates in Number of write points (Points). The data stored in Write data 1 (Data1) is the PROFILE_CAM_DATA type data when Specifying interpolation method (Interpolate) is "0: Linear interpolation". The data stored in Write data 2 (Data2) is data defined by using set coordinate data (a pair of input value (current value per cycle) and output value (stroke)) in LREAL type two-dimensional array.</p> <p>&lt;Example&gt;</p> <p>Write result of Write data 2 (Data2) when Offset (Offset) is set to "2" and Number of write data (Points) is set to "3". (When the variable set to Write data 2 (Data2) is a "LREAL[1..8,1..2]" data type "CamData2" label.)</p> <div><div><p>&lt;Variable (label/device)&gt;<br/>Two-dimensional array label of LREAL type<br/>(CamData2[1..8,1..2])</p><table><thead><tr><th></th><th>CamData[n][1]</th><th>CamData[n][2]</th></tr></thead><tbody><tr><td>n=1</td><td>Input value at the 2nd point</td><td>Output value at the 2nd point</td></tr><tr><td>n=2</td><td>Input value at the 3rd point</td><td>Output value at the 3rd point</td></tr><tr><td>n=3</td><td>Input value at the 4th point</td><td>Output value at the 4th point</td></tr><tr><td>n=4</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=5</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=6</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=7</td><td>Not updating</td><td>Not updating</td></tr><tr><td>n=8</td><td>Not updating</td><td>Not updating</td></tr></tbody></table></div><div><p>Offset</p><p>Number of write data (Points)</p></div><div><p>&lt;Open area/file&gt;*1</p><table><thead><tr><th></th><th>Input value</th><th>Output value</th></tr></thead><tbody><tr><td></td><td>at the 0th point</td><td>at the 0th point</td></tr><tr><td></td><td>at the 1st point</td><td>at the 1st point</td></tr><tr><td></td><td>at the 2nd point</td><td>at the 2nd point</td></tr><tr><td></td><td>at the 3rd point</td><td>at the 3rd point</td></tr><tr><td></td><td>at the 4th point</td><td>at the 4th point</td></tr><tr><td></td><td>at the 5th point</td><td>at the 5th point</td></tr><tr><td></td><td>at the 6th point</td><td>at the 6th point</td></tr><tr><td></td><td>at the 7th point</td><td>at the 7th point</td></tr></tbody></table></div></div> <p>*1: Depends on Read destination (Target).</p> |                               | CamData[n][1] | CamData[n][2] | n=1 | Input value at the 2nd point | Output value at the 2nd point | n=2 | Input value at the 3rd point | Output value at the 3rd point | n=3 | Input value at the 4th point | Output value at the 4th point | n=4 | Not updating | Not updating | n=5 | Not updating | Not updating | n=6 | Not updating | Not updating | n=7 | Not updating | Not updating | n=8 | Not updating | Not updating |  | Input value | Output value |  | at the 0th point | at the 0th point |  | at the 1st point | at the 1st point |  | at the 2nd point | at the 2nd point |  | at the 3rd point | at the 3rd point |  | at the 4th point | at the 4th point |  | at the 5th point | at the 5th point |  | at the 6th point | at the 6th point |  | at the 7th point | at the 7th point |
|                                               | CamData[n][1]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CamData[n][2]                 |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
| n=1                                           | Input value at the 2nd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Output value at the 2nd point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
| n=2                                           | Input value at the 3rd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Output value at the 3rd point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
| n=3                                           | Input value at the 4th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Output value at the 4th point |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
| n=4                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Not updating                  |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
| n=5                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Not updating                  |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
| n=6                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Not updating                  |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
| n=7                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Not updating                  |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
| n=8                                           | Not updating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Not updating                  |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
|                                               | Input value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Output value                  |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
|                                               | at the 0th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | at the 0th point              |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
|                                               | at the 1st point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | at the 1st point              |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
|                                               | at the 2nd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | at the 2nd point              |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
|                                               | at the 3rd point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | at the 3rd point              |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
|                                               | at the 4th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | at the 4th point              |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
|                                               | at the 5th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | at the 5th point              |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
|                                               | at the 6th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | at the 6th point              |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
|                                               | at the 7th point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | at the 7th point              |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
| 1: Specifying for each section                | <p>Specifying a section for write is not possible.</p> <p>Sets Offset (Offset) and Number of write data (Points) to "0", and writes the entire operation profile data. When a value other than "0" is set, Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs. The data stored in Write data 1 (Data1) is the PROFILE_CAM_DATA type data when Specifying interpolation method (Interpolate) is "1: Specifying for each section" or "2: Spline interpolation". The data stored in Write data 2 (Data2) is section data defined in PROFILE_CAM_ELEMENT type array.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                               |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |
| 2: Spline interpolation                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                               |               |               |     |                              |                               |     |                              |                               |     |                              |                               |     |              |              |     |              |              |     |              |              |     |              |              |     |              |              |  |             |              |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |  |                  |                  |

- When the operation profile data format is "rotary cutter"

Specifying a section for write is not possible. This format sets the Offset (Offset) and Number of write data (Points) to "0", and writes the entire operation profile data. The setting input manually for Offset (Offset) and the Number of write data (Points) is ignored. The data stored in Write data 1 (Data1) is data where the operation profile data format is PROFILE\_ROTARY\_CUTTER type "rotary cutter". Write data 2 (Data2) is not used.

- When the operation profile data format is "Multiple Axes Positioning Data"

| Write destination (Target)               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                      |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------------|-------------------------------------|-----|-----|-------------------------------|--------------------------------------|-----|-----|------------------------------|-------------------------------------|-----|-----|------------|------------|-----|-----|------------|------------|-----|-----|------------|------------|-----|-----|------------|------------|-----|-----|------------|------------|-----|------------------------------|-------------------------------------|-----|-------------------------------|--------------------------------------|-----|------------------------------|-------------------------------------|-----|-------------------------------|--------------------------------------|-----|------------------------------|-------------------------------------|-----|------------------------------|-------------------------------------|-----|-----|-----|-----|-----|------------------------------|-------------------------------------|-----|-----|-----------|------------|-----|-----|------------------------------|-------------------------------------|-----|-----|------------|------------|-----|-----|------------|------------|-----|-----|------------|------------|-----|-----|------------|------------|-----|-----|------------|------------|-----|------------------------------|-------------------------------------|-----|-------------------------------|--------------------------------------|-----|------------------------------|-------------------------------------|-----|-------------------------------|-----------------------------------------|-----------------|------------------------------|-------------------------------------|-----|------------------------------|-------------------------------------|-----|-----|-----|-----|
| 0: Open area                             | Specify the top of the section to which positioning data is written in Offset (Offset), and the Number of sections (NumberOfSections) in Number of write data (Points).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                      |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| 2: Open area (motion service processing) | <p>Data is written to a PROFILE_POSITIONING_DATA type variable specified in Data1 (TARGET_REF type).</p> <p>When a PROFILE_POSITIONING_DATA_ELEMENT type array variable is specified in Data2 (TARGET_REF type), positioning data is written from the specified variable.</p> <p>Example:</p> <p>Write result of Write data 2 (Data2) when Offset (Offset) is set to "2" and Number of write data (Points) is set to "3".</p> <p>(When the variable set to Write data 2 (Data2) is a "PROFILE_POSITIONING_DATA_ELEMENT[1..8]" data type "PositioningData2" label)</p> <div><div><p>&lt;Variable (label/device)&gt;<br/>PROFILE_POSITIONING_DATA_ELEMENT type label<br/>(PositioningData2[1..8])</p><table><tr><td>n=1</td><td>DataNo(3) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td>n=2</td><td>DataNo(4) of the fourth point</td><td>OperationPattern of the fourth point</td><td>...</td></tr><tr><td>n=3</td><td>DataNo(5) of the fifth point</td><td>OperationPattern of the fifth point</td><td>...</td></tr><tr><td>n=4</td><td>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=5</td><td>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=6</td><td>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=7</td><td>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=8</td><td>(Not used)</td><td>(Not used)</td><td>...</td></tr></table></div><div><p>Offset (Offset)</p><p>Number of write data (Points)</p></div><div><p>&lt;Open area&gt;</p><table><tr><td>DataNo(1) of the first point</td><td>OperationPattern of the first point</td><td>...</td></tr><tr><td>DataNo(2) of the second point</td><td>OperationPattern of the second point</td><td>...</td></tr><tr><td>DataNo(3) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td>DataNo(4) of the fourth point</td><td>OperationPattern of the fourth point</td><td>...</td></tr><tr><td>DataNo(5) of the fifth point</td><td>OperationPattern of the fifth point</td><td>...</td></tr><tr><td>DataNo(6) of the sixth point</td><td>OperationPattern of the sixth point</td><td>...</td></tr><tr><td>...</td><td>...</td><td>...</td></tr></table></div></div> <p>Specify DataNo of each positioning data in the specified variable so that it matches the write destination DataNo.</p> <ul style="list-style-type: none"><li>• When there is positioning data whose DataNo is "0", it is considered as unset, and the initial value is stored in the section data with the corresponding DataNo. (DataNo will be 0.)</li></ul> <p>Example:</p> <p>When DataNo with variable n = 2 is set to 0 in the above example</p> <div><div><p>&lt;Variable (label/device)&gt;<br/>PROFILE_POSITIONING_DATA_ELEMENT type label<br/>(PositioningData2[1..8])</p><table><tr><td>n=1</td><td>DataNo(3) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td>n=2</td><td>DataNo(0)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=3</td><td>DataNo(5) of the fifth point</td><td>OperationPattern of the fifth point</td><td>...</td></tr><tr><td>n=4</td><td>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=5</td><td>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=6</td><td>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=7</td><td>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=8</td><td>(Not used)</td><td>(Not used)</td><td>...</td></tr></table></div><div><p>Offset (Offset)</p><p>Number of write data (Points)</p></div><div><p>&lt;Open area&gt;</p><table><tr><td>DataNo(1) of the first point</td><td>OperationPattern of the first point</td><td>...</td></tr><tr><td>DataNo(2) of the second point</td><td>OperationPattern of the second point</td><td>...</td></tr><tr><td>DataNo(3) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td>DataNo(0) of the fourth point</td><td>OperationPattern(0) of the fourth point</td><td>(Initial value)</td></tr><tr><td>DataNo(5) of the fifth point</td><td>OperationPattern of the fifth point</td><td>...</td></tr><tr><td>DataNo(6) of the sixth point</td><td>OperationPattern of the sixth point</td><td>...</td></tr><tr><td>...</td><td>...</td><td>...</td></tr></table></div></div> <p>If there is positioning data whose DataNo is "0" or does not match any of the write destination DataNo, Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs.</p> <p>When a PROFILE_POSITIONING_DATA_EXTENDED type variable is specified in Data2 (TARGET_REF type)</p> <p>The condition signal, skip signal, and positioning data are written from their corresponding variables specified as the WSTRING type in variable members ConditionSignal, SkipSignal, and PositioningData.</p> <p>For the condition signal and skip signal, specify the PROFILE_SIGNAL_SELECT_ELEMENT type array data.</p> <p>For positioning data, specify the PROFILE_POSITIONING_DATA_ELEMENT type array data. (This behavior is the same as specifying a PROFILE_POSITIONING_DATA_ELEMENT type array variable as Data2 (TARGET_REF type).)</p> | n=1                                  | DataNo(3) of the third point | OperationPattern of the third point | ... | n=2 | DataNo(4) of the fourth point | OperationPattern of the fourth point | ... | n=3 | DataNo(5) of the fifth point | OperationPattern of the fifth point | ... | n=4 | (Not used) | (Not used) | ... | n=5 | (Not used) | (Not used) | ... | n=6 | (Not used) | (Not used) | ... | n=7 | (Not used) | (Not used) | ... | n=8 | (Not used) | (Not used) | ... | DataNo(1) of the first point | OperationPattern of the first point | ... | DataNo(2) of the second point | OperationPattern of the second point | ... | DataNo(3) of the third point | OperationPattern of the third point | ... | DataNo(4) of the fourth point | OperationPattern of the fourth point | ... | DataNo(5) of the fifth point | OperationPattern of the fifth point | ... | DataNo(6) of the sixth point | OperationPattern of the sixth point | ... | ... | ... | ... | n=1 | DataNo(3) of the third point | OperationPattern of the third point | ... | n=2 | DataNo(0) | (Not used) | ... | n=3 | DataNo(5) of the fifth point | OperationPattern of the fifth point | ... | n=4 | (Not used) | (Not used) | ... | n=5 | (Not used) | (Not used) | ... | n=6 | (Not used) | (Not used) | ... | n=7 | (Not used) | (Not used) | ... | n=8 | (Not used) | (Not used) | ... | DataNo(1) of the first point | OperationPattern of the first point | ... | DataNo(2) of the second point | OperationPattern of the second point | ... | DataNo(3) of the third point | OperationPattern of the third point | ... | DataNo(0) of the fourth point | OperationPattern(0) of the fourth point | (Initial value) | DataNo(5) of the fifth point | OperationPattern of the fifth point | ... | DataNo(6) of the sixth point | OperationPattern of the sixth point | ... | ... | ... | ... |
| n=1                                      | DataNo(3) of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | OperationPattern of the third point  | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=2                                      | DataNo(4) of the fourth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | OperationPattern of the fourth point | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=3                                      | DataNo(5) of the fifth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | OperationPattern of the fifth point  | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=4                                      | (Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=5                                      | (Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=6                                      | (Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=7                                      | (Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=8                                      | (Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(1) of the first point             | OperationPattern of the first point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(2) of the second point            | OperationPattern of the second point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(3) of the third point             | OperationPattern of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(4) of the fourth point            | OperationPattern of the fourth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(5) of the fifth point             | OperationPattern of the fifth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(6) of the sixth point             | OperationPattern of the sixth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| ...                                      | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=1                                      | DataNo(3) of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | OperationPattern of the third point  | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=2                                      | DataNo(0)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | (Not used)                           | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=3                                      | DataNo(5) of the fifth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | OperationPattern of the fifth point  | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=4                                      | (Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=5                                      | (Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=6                                      | (Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=7                                      | (Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| n=8                                      | (Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                          |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(1) of the first point             | OperationPattern of the first point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(2) of the second point            | OperationPattern of the second point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(3) of the third point             | OperationPattern of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(0) of the fourth point            | OperationPattern(0) of the fourth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | (Initial value)                      |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(5) of the fifth point             | OperationPattern of the fifth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| DataNo(6) of the sixth point             | OperationPattern of the sixth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |
| ...                                      | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ...                                  |                              |                                     |     |     |                               |                                      |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                              |                                     |     |     |     |     |     |                              |                                     |     |     |           |            |     |     |                              |                                     |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |     |            |            |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                               |                                         |                 |                              |                                     |     |                              |                                     |     |     |     |     |

| Write destination (Target)      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                      |                         |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------------|------------|-----|-----|------------------------------|-------------------------------------|-----|-----|-------------------------------|--------------------------------------|-----|-----|-------------------------|------------|-----|-----|------------------------------|-------------------------------------|-----|-----|-------------------------|------------|-----|--|-----|-----|-----|------|-------------------------|------------|-----|-------|---------------------------------|--------------------------------------|-----|------------------------------|-------------------------------------|-----|-------------------------------|--------------------------------------|-----|------------------------------|-------------------------------------|-----|---------------------------------|--------------------------------------|-----|
| 1: File                         | <p>Specify Offset (Offset) and Number of write data (Points) to 0, and write the data to the entire operation profile data.<br/>(When a value other than 0 is set, Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs.)<br/>The PROFILE_POSITIONING_DATA type data is written from the variable specified in Data1 (TARGET_REF type).<br/>When a PROFILE_POSITIONING_DATA_ELEMENT type array variable is specified in Data2 (TARGET_REF type), positioning data is written from the specified variable.</p> <p>When there is positioning data whose positioning data number is "0" is present in the write destination section, the section data with the corresponding DataNo is not written.</p> <p>Example:</p> <p>Write result of Write data 2 (Data2) when Offset (Offset) is set to "0" and Number of write data (Points) is set to "0"<br/>(When the variable set to Write data 2 (Data2) is a "PROFILE_POSITIONING_DATA_ELEMENT[1..100]" data type "PositioningData2" label)</p> <div><div><p>&lt;Variable (label/device)&gt;<br/>PROFILE_POSITIONING_DATA_ELEMENT type label<br/>(PositioningData2[1..100])</p><table><tr><td>n=1</td><td>DataNo(0)<br/>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=2</td><td>DataNo(2) of the first point</td><td>OperationPattern of the first point</td><td>...</td></tr><tr><td>n=3</td><td>DataNo(3) of the second point</td><td>OperationPattern of the second point</td><td>...</td></tr><tr><td>n=4</td><td>DataNo(0)<br/>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=5</td><td>DataNo(5) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td>n=6</td><td>DataNo(0)<br/>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td></td><td>...</td><td>...</td><td>...</td></tr><tr><td>n=99</td><td>DataNo(0)<br/>(Not used)</td><td>(Not used)</td><td>...</td></tr><tr><td>n=100</td><td>DataNo(100) of the fourth point</td><td>OperationPattern of the fourth point</td><td>...</td></tr></table></div><div><p>&lt;File&gt;</p><table><tr><td>DataNo(2) of the first point</td><td>OperationPattern of the first point</td><td>...</td></tr><tr><td>DataNo(3) of the second point</td><td>OperationPattern of the second point</td><td>...</td></tr><tr><td>DataNo(5) of the third point</td><td>OperationPattern of the third point</td><td>...</td></tr><tr><td>DataNo(100) of the fourth point</td><td>OperationPattern of the fourth point</td><td>...</td></tr></table></div></div> <p>When a PROFILE_POSITIONING_DATA_EXTENDED type variable is specified in Data2 (TARGET_REF type)<br/>The condition signal, skip signal, and positioning data are written from their corresponding variables specified as the WSTRING type in variable members ConditionSignal, SkipSignal, and PositioningData.<br/>For the condition signal and skip signal, specify the PROFILE_SIGNAL_SELECT_ELEMENT type array data.<br/>For positioning data, specify the PROFILE_POSITIONING_DATA_ELEMENT type array data. (This behavior is the same as specifying a PROFILE_POSITIONING_DATA_ELEMENT type array variable as Data2 (TARGET_REF type).)</p> | n=1                                  | DataNo(0)<br>(Not used) | (Not used) | ... | n=2 | DataNo(2) of the first point | OperationPattern of the first point | ... | n=3 | DataNo(3) of the second point | OperationPattern of the second point | ... | n=4 | DataNo(0)<br>(Not used) | (Not used) | ... | n=5 | DataNo(5) of the third point | OperationPattern of the third point | ... | n=6 | DataNo(0)<br>(Not used) | (Not used) | ... |  | ... | ... | ... | n=99 | DataNo(0)<br>(Not used) | (Not used) | ... | n=100 | DataNo(100) of the fourth point | OperationPattern of the fourth point | ... | DataNo(2) of the first point | OperationPattern of the first point | ... | DataNo(3) of the second point | OperationPattern of the second point | ... | DataNo(5) of the third point | OperationPattern of the third point | ... | DataNo(100) of the fourth point | OperationPattern of the fourth point | ... |
| n=1                             | DataNo(0)<br>(Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                     |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=2                             | DataNo(2) of the first point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | OperationPattern of the first point  | ...                     |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=3                             | DataNo(3) of the second point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | OperationPattern of the second point | ...                     |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=4                             | DataNo(0)<br>(Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                     |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=5                             | DataNo(5) of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | OperationPattern of the third point  | ...                     |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=6                             | DataNo(0)<br>(Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                     |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
|                                 | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ...                                  | ...                     |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=99                            | DataNo(0)<br>(Not used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Not used)                           | ...                     |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| n=100                           | DataNo(100) of the fourth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | OperationPattern of the fourth point | ...                     |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| DataNo(2) of the first point    | OperationPattern of the first point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ...                                  |                         |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| DataNo(3) of the second point   | OperationPattern of the second point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ...                                  |                         |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| DataNo(5) of the third point    | OperationPattern of the third point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ...                                  |                         |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |
| DataNo(100) of the fourth point | OperationPattern of the fourth point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ...                                  |                         |            |     |     |                              |                                     |     |     |                               |                                      |     |     |                         |            |     |     |                              |                                     |     |     |                         |            |     |  |     |     |     |      |                         |            |     |       |                                 |                                      |     |                              |                                     |     |                               |                                      |     |                              |                                     |     |                                 |                                      |     |



- When the operation profile data format is "Digital Cam Switch Data"

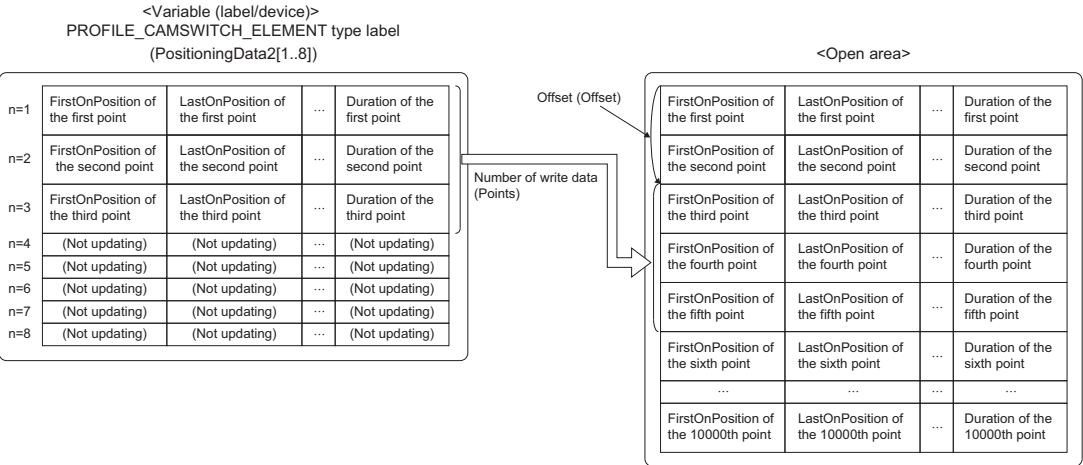
The top of the section to be written is set in Offset (Offset), and the Number of sections (NumberOfSections) in Number of write data (Points).

Specify PROFILE\_CAMSWITCH\_DATA type data in Write data 1 (Data1).

Specify the data for which the data of switch settings (FirstOnPosition, LastOnPosition, Direction, CamSwitchMode, and Duration) is defined as the PROFILE\_CAMSWITCH\_ELEMENT type array in Write data 2 (Data2).

Example:

Write result of Write data 2 (Data2) when Offset (Offset) is set to "0" and Number of write data (Points) is set to "3"  
(When the variable set to Write data 2 (Data2) is a "PROFILE\_CAMSWITCH\_ELEMENT[1..8]" data type  
"DigitalCamSwitchData2" label)



## ■Write data 1 (Data1)/Write data 2 (Data2)

Set write data of the operation profile data with a TARGET\_REF structure. The [VAR] and [DEV] data types can be used. For details on the TARGET\_REF structure, refer to the following.

📖 Page 1489 TARGET\_REF (Input signal)

For data types, write data structures of each operation profile data format can be used.

### • Write data 1 (Data1)

The operation profile data formats and data types set in Write data 1 (Data1) are shown below.

| Operation profile data format | Data type             | Reference                       |
|-------------------------------|-----------------------|---------------------------------|
| Cam data                      | PROFILE_CAM_DATA      | Page 1494 PROFILE_CAM_DATA      |
| Cam data for rotary cutter    | PROFILE_ROTARY_CUTTER | Page 1496 PROFILE_ROTARY_CUTTER |

### Ex.

When writing by using a device or label

#### • When writing a PROFILE\_CAM\_DATA type label (CamData1)

Data1.Target := "[VAR]CamData1"

#### • Write data 2 (Data2)

The operation profile data formats and data types set in Write data 2 (Data2) are shown below. The data type of the structure that is set varies depending on the Write destination (Target) and Specifying interpolation method (Interpolate) of the target cam data.

If the number of elements of the specified array is less than (the resolution + 1/number of coordinates) when the entire operation profile data is written, Number of Read/Write Data Mismatch (error code: 1BACH) occurs.

○: Supported, ×: Not supported

| Operation profile data format | Data type                                                  | Specifying interpolation method (Interpolate) |                                |                         | Reference                     |
|-------------------------------|------------------------------------------------------------|-----------------------------------------------|--------------------------------|-------------------------|-------------------------------|
|                               |                                                            | 0: Linear interpolation                       | 1: Specifying for each section | 2: Spline interpolation |                               |
| Cam data                      | LREAL[] <sup>*1</sup>                                      | ○                                             | ×                              | ×                       | —                             |
|                               | PROFILE_CAM_ELEMENT[] <sup>*2</sup>                        | ×                                             | ○                              | ○ <sup>*3</sup>         | Page 1495 PROFILE_CAM_ELEMENT |
| Cam data for rotary cutter    | Setting is unnecessary.<br>If set, the setting is ignored. |                                               |                                |                         | —                             |

\*1 The LREAL type two-dimensional array is set as follows.

LREAL[m..n,o..p]

| Item                         | Description                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of elements (n-m+1)   | Sets the array elements so that they are greater than the number of points that are to be read.<br>When writing the entire operation profile data (Offset (Offset), Number of write data (Points) are set to "0"), set this to the cam data resolution +1/number of coordinates or more.<br>However, an area bigger than the resolution +1/number of coordinates in Write data 1 (Data1) will not be updated. |
| Number of dimensions (p-o+1) | The stroke and current position per cycle for each point are written.<br>Set the array element to "2".<br>If the array element is set to "3" or more, a write is possible, but as the intended result of the write may not be obtained due to data being moved forward, make sure to set the array element to "2".                                                                                            |

\*2 The PROFILE\_CAM\_ELEMENT array is set as follows.

PROFILE\_CAM\_ELEMENT[m..n]

| Item                       | Description                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of elements (n-m+1) | Sets the array elements so that they are greater than the number of points that are to be read.<br>When reading the entire operation profile data (Offset (Offset), Number of read data (Points) are set to "0"), set this to the cam data Number of sections (NumberOfSections) or more.<br>However, an area bigger than the Number of sections (NumberOfSections) in Write data 1 (Data1) will not be updated. |

\*3 Only used by the end point and stroke.

**Ex.**

For LREAL type

| Specifying interpolation method (Interpolate) | Setting example                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Linear interpolation                       | <p>The following shows examples of setting the two-dimensional label coordinate number "100" to Target (Target) of the TARGET_REF structure.</p> <p>Data2.Target := "[VAR]CamData2"</p> <ul style="list-style-type: none"> <li>* CamData2 declares the "LREAL[1..100,1..2]" label to data type and label name of the global label to "CamData2", and specifies the character string for Target (Target). The write data is as shown below. <ul style="list-style-type: none"> <li>· CamData2[n,1]: nth point current position per cycle</li> <li>· CamData2[n,2]: nth point stroke</li> </ul> </li> </ul> |
| 1: Section interpolation                      | <p>The following shows examples of setting the two-dimensional label resolution "100" to Target (Target) of the TARGET_REF structure.</p> <p>TARGET_REF.Target := "[VAR]CamData2"</p>                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 2: Spline interpolation                       | <ul style="list-style-type: none"> <li>* CamData2 declares the "LREAL[1..101,1..2]" label to data type and label name of the global label to "CamData2", and specifies the character string for Target (Target). The write data is as shown below. <ul style="list-style-type: none"> <li>· CamData2[1,1]: Value set for the start point</li> <li>· CamData2[1,2]: Value set for the initial stroke amount</li> <li>· CamData2[n+1,1]: nth point current position per cycle</li> <li>· CamData2[n+1,2]: nth point stroke</li> </ul> </li> </ul>                                                           |

**Ex.**

For PROFILE\_CAM\_ELEMENT type

| Setting example                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The following shows examples of setting the two-dimensional label number of sections "10" to Target (Target) of the TARGET_REF structure.</p> <p>Data2.Target := "[VAR]CamData2"</p> <ul style="list-style-type: none"> <li>* CamData2 declares the "PROFILE_CAM_ELEMENT[1..10]" label to data type and label name of the global label to "CamData2", and specifies the character string for Target (Target). The write data is as shown below. <ul style="list-style-type: none"> <li>· CamData2[n]: nth point section data (PROFILE_CAM_ELEMENT type)</li> </ul> </li> </ul> |

### Point

- If the type of the specified data structure for writing does not match the type that is required for each operation profile data, Read/Write Data Type Incorrect (error code: 1BAAH) occurs.
- For details on the cam data for the operation profile data set in Write data 1 (Data1)/Write data 2 (Data2), refer to the following.
  -  User's manual for the controller used
- If the Write destination (Target) of MCv\_WriteProfileData (Profile Write) is set to "1: File" with an LREAL type array and then data is written, the data is output to the file with Specifying interpolation method (Interpolate) for the cam data format set to "0: Linear Interpolation".

## ■Write destination (Target)

Sets the write destination of the operation profile data, and writes Write Data 1 (Data1)/Write Data 2 (Data2) and the Profile ID (PROFILE\_ID) of the operation profile data open FB.

| Setting value                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Open area                             | <ul style="list-style-type: none"> <li>The Profile ID (ID) value of the PROFILE_DATA structure is referred to, and the write is performed for the operation profile data that Profile ID No. (Number) of the PROFILE_ID structure indicates in the open area.</li> <li>The write is performed at the cycle of the executed program.</li> </ul> <p>■When "0" is set in Profile ID No. (Number) of the PROFILE_ID structure<br/>An available ID is assigned automatically, and the ID is stored in profile ID No. (Number).<br/>If an FB with Profile ID No. (Number) specified as "0" is executed multiple times to the same operation profile data, the data will be opened in multiple different open areas.<br/>When no ID is available, Insufficient Operation Profile Data ID (error code: 1BA0H) will occur and open processing will not be performed.</p> <p>■When "1 to 60000" is set in Profile ID No. (Number) of the PROFILE_ID structure<br/>The set ID is opened without changing the ID.<br/>If setting an ID that has been already opened, the open data will be overwritten.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 1: File                                  | <ul style="list-style-type: none"> <li>The Profile ID (ID) value of the PROFILE_DATA structure is referred, and the write is performed for the operation profile data that Profile ID No. (Number) of the PROFILE_ID structure indicates in the open area. Following this, the Operation profile data storage location (Location) value of the PROFILE_DATA structure is referred, and the write is performed for the operation profile data that the File name (Filename) and Folder specification (Path) indicate within the FILE_LOCATION structure. With the Profile ID of the operation profile data, the Profile ID (ProfileID) value of the output variable will be written in the file.</li> <li>The write is performed at the cycle of the motion service processing.</li> <li>If Operation profile data storage location (Location) of the PROFILE_DATA structure is not set, No Operation Profile Data (error code: 1B8EH) occurs and the write processing is not performed.</li> <li>If the specified file exists, the file is overwritten.</li> <li>If the specified file does not exist, a new file will be created and written in "Unicode (UTF-16 Little Endian with BOM)" if the value in both Offset (Offset) and Number of write data (Points) is "0".</li> <li>When creating a new file, both Offset (Offset) and Number of write data (Points) must be "0", otherwise Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs. (Write to the open area is executed.)</li> <li>When set to "1: File", set Offset (Offset) and Number of write data (Points) to "0". (When a value other than 0 is set, Number of Offset/Read/Write Data Incorrect (error code: 1BADH) occurs.)</li> </ul> |
| 2: Open area (motion service processing) | <ul style="list-style-type: none"> <li>The Profile ID (ID) value of the PROFILE_DATA structure is referred, and the write is performed for the operation profile data that Profile ID No. (Number) of the PROFILE_ID structure indicates in the open area.</li> <li>The write is performed at the cycle of the motion service processing.</li> </ul> <p>■When "0" is set in Profile ID No. (Number) of the PROFILE_ID structure<br/>An available ID is assigned automatically, and the ID is stored in profile ID No. (Number).<br/>If an FB with Profile ID No. (Number) specified as "0" is executed multiple times to the same operation profile data, the data will be opened in multiple different open areas.<br/>When no ID is available, Insufficient Operation Profile Data ID (error code: 1BA0H) will occur and open processing will not be performed.</p> <p>■When "1 to 60000" is set in Profile ID No. (Number) of the PROFILE_ID structure<br/>The set ID is opened without changing the ID.<br/>If setting an ID that has been already opened, the open data will be overwritten.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

### Point

- When Read destination (Target) is "1: File" or "2: Open area (motion service processing)", as motion service processing is used in that case, it may take much time for the processing to complete. Use Done (Execution completion) for the interlock as needed.
- When Target is set to "0: Open area", the processing is completed immediately as it is performed within the task where the FB is called. The program execution time increases when the number of write data points is too large. Therefore, execute the write multiple times with smaller data quantities as needed, or use the setting with Target set to "2: Open area (motion service processing)".

## ■ Execution mode (ExecutionMode)

Sets the timing for executing MCv\_WriteProfileData (Profile Write).

| Setting value                                 | Description                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0: Execute immediately<br>(mcImmediately)     | The contents of the open area are immediately written.<br>The writing may affect the control in execution.<br>Note that if the operation profile data format and resolution do not match when performing a write during FB execution, Operation Profile Data Being Operated (error code: 1B90H) occurs. |
| 1: Execute at completion (mcQueued)           | Waits for the FB being executed to complete, then performs writing.<br>When multiple FBs are waiting, the FBs will be executed in order of task priority.<br>FBs of the same priority are executed according to the start order.                                                                        |
| 3: Execute speculatively<br>(mcSpeculatively) | Operation profile data being operated (error code: 1B90H) occurs and the open area is not changed.                                                                                                                                                                                                      |

### Point

When no FB is in execution, the FB is executed immediately regardless of the setting of Execution mode (ExecutionMode).

When FBs in execution are accessing the open area, Executing (Busy) of each FB accessing the open area becomes TRUE. Use Execution mode (ExecutionMode) for the interlock as needed.

## Precautions

The number of data points that can be written at the same time are limited. If the write is not completed in a single FB execution, execute the write over several FB executions.

## Program example

The following is a program example. "LREAL type (two-dimensional array) format" cam data 1 (ProfileData0001) and "PROFILE\_CAM\_ELEMENT format" cam data 2 (ProfileData0002) are written to the file.

### ■Operation profile data

| Profile ID | Label name      | Data type  | Comment    |
|------------|-----------------|------------|------------|
| 1          | ProfileData0001 | MC_CAM_REF | Cam data 1 |
| 2          | ProfileData0002 | MC_CAM_REF | Cam data 2 |

#### • Operation profile data (cam data) settings

| Item                            |                  | ProfileData0001      | ProfileData0002             |
|---------------------------------|------------------|----------------------|-----------------------------|
| Specifying interpolation method |                  | Linear interpolation | Specifying for each section |
| Resolution                      |                  | —                    | 256                         |
| Length per cycle setting        | Unit             | degree               | degree                      |
|                                 | Length per cycle | 360.00000            | 360.00000                   |
| Stroke amount                   | Unit             | pulse                | %                           |
|                                 | Stroke amount    | 100.0                | 100.0000000                 |
| Cam 1 cycle time                |                  | —                    | 1.000[s]                    |
| Initial stroke value            |                  | —                    | 0.0000000                   |
| Cam 1 stroke minimum value      |                  | 0.00000              | —                           |
| Cam 1 stroke maximum value      |                  | 360.00000            | —                           |

#### • ProfileData0001

| Section No. | Input value [degree] | Output value [pulse] |
|-------------|----------------------|----------------------|
| 1           | 0.00000              | 0.0                  |
| 2           | 90.00000             | 60.0                 |
| 3           | 180.00000            | 100.0                |
| 4           | 270.00000            | 30.0                 |
| 5           | 360.00000            | 0.0                  |

#### • ProfileData0002

| Section No. | Start point [degree] | End point [degree] | Stroke [%]  | Cam curve type    |
|-------------|----------------------|--------------------|-------------|-------------------|
| 1           | 0.00000              | 90.00000           | 60.0000000  | Single hypotenuse |
| 2           | 90.00000             | 180.00000          | 100.0000000 | Single hypotenuse |
| 3           | 180.00000            | 270.00000          | 30.0000000  | Single hypotenuse |
| 4           | 270.00000            | 0.00000            | 0.0000000   | Single hypotenuse |

## ■Labels used

| Label name                        | Data type                               | Comment                                 |
|-----------------------------------|-----------------------------------------|-----------------------------------------|
| MCv_WriteProfileData_1            | MCv_WriteProfileData                    | Profile Write FB 1                      |
| WriteData1_1                      | TARGET_REF                              | Write data 1 Profile 1                  |
| WriteData2_1                      | TARGET_REF                              | Write data 2 Profile 1                  |
| WriteData1_Lreal                  | PROFILE_CAM_DATA                        | Profile data 1 Cam data 1               |
| WriteData2_Lreal                  | Double-precision real number(0..4,0..1) | Profile data 1 LREAL type               |
| bWriteProfile1                    | Bit                                     | Profile write command 1                 |
| bDone1                            | Bit                                     | Completion 1                            |
| bBusy1                            | Bit                                     | Executing 1                             |
| bError1                           | Bit                                     | Error 1                                 |
| uwErrorID1                        | Word [unsigned]/bit string [16-bit]     | Error code 1                            |
| ProfileID1                        | PROFILE_ID                              | Profile ID 1                            |
| Cam_ProfileData0001 <sup>*1</sup> | PROFILE_DATA                            | Profile data 0001                       |
| MCv_WriteProfileData_2            | MCv_WriteProfileData                    | Profile Write FB 2                      |
| WriteData1_2                      | TARGET_REF                              | Write data 1 Profile 2                  |
| WriteData2_2                      | TARGET_REF                              | Write data 2 Profile 2                  |
| WriteData1_Element                | PROFILE_CAM_DATA                        | Profile data 2 Cam data 2               |
| WriteData2_Element                | PROFILE_CAM_ELEMENT(0..3)               | Profile data 2 PROFILE_CAM_ELEMENT type |
| bWriteProfile2                    | Bit                                     | Profile write command 2                 |
| bDone2                            | Bit                                     | Completion 2                            |
| bBusy2                            | Bit                                     | Executing 2                             |
| bError2                           | Bit                                     | Error 2                                 |
| uwErrorID2                        | Word [unsigned]/bit string [16-bit]     | Error code 2                            |
| ProfileID2                        | PROFILE_ID                              | Profile ID 2                            |
| Cam_ProfileData0002 <sup>*1</sup> | PROFILE_DATA                            | Profile data 0002                       |

\*1 Only used in FBD/LD programs. (Required to use the operation profile data in FBD/LD programs.)

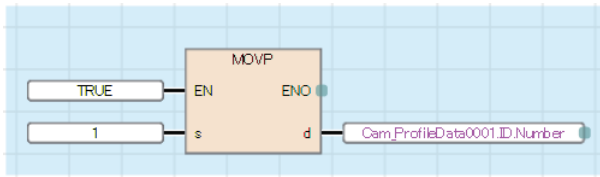
## ■Global labels used

| Label name                        | Data type           | Comment             | Public label |
|-----------------------------------|---------------------|---------------------|--------------|
| G_ProfileCamData <sup>*1</sup>    | PROFILE_CAM_DATA    | Profile cam data    | Enabled      |
| G_ProfileCamELEMENT <sup>*1</sup> | PROFILE_CAM_ELEMENT | Profile cam element | Enabled      |

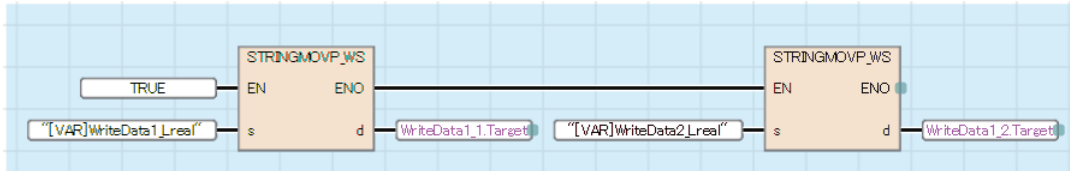
\*1 Only used in FBD/LD programs. (Required to use the operation profile data in FBD/LD programs.)

## ■FBD/LD program

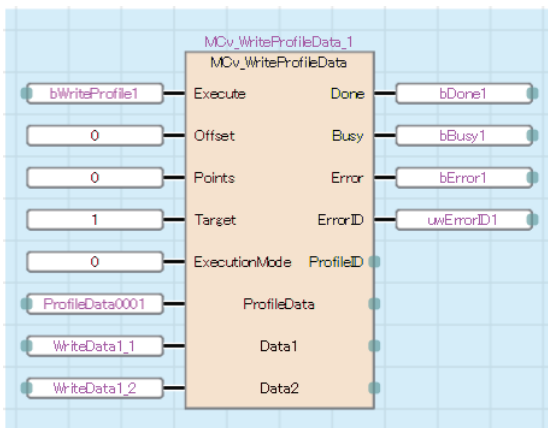
- Profile data 0001



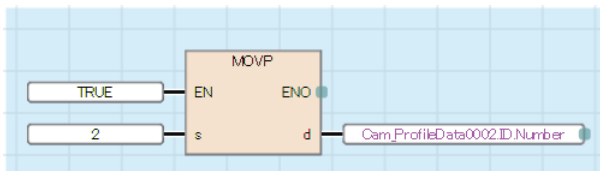
- Write data 1



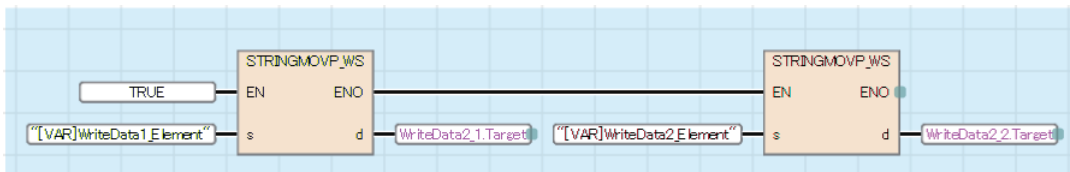
- Profile Write 1 (writes cam data in the LREAL type (two-dimensional array) format)



- Profile data 0002

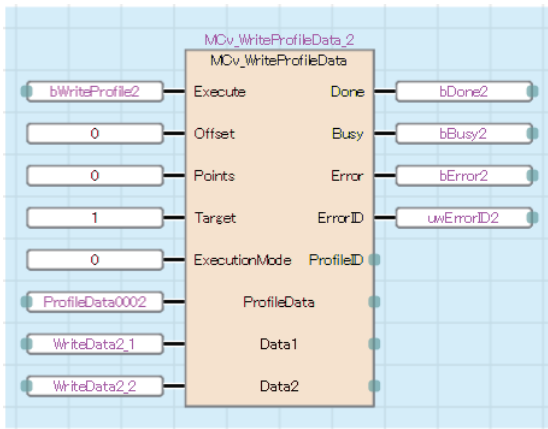


- Write data 2



- Profile Write 2 (writes cam data in the PROFILE\_CAM\_ELEMENT type format)





## ■ST program

```
//-----Write data 1-----
WriteData1_1.Target := "[VAR]WriteData1_Lreal";
WriteData1_2.Target := "[VAR]WriteData2_Lreal";

//-----Profile Write 1-----
//-----Writes cam data in the LREAL type (two-dimensional array) format-----
MCv_WriteProfileData_1(
  ProfileData:= ProfileData0001.ProfileData ,
  Data1:= WriteData1_1 ,
  Data2:= WriteData1_2 ,
  Execute:= bWriteProfile1 ,
  Offset:= 0 ,
  Points:= 0 ,
  Target:= 1 ,
  ExecutionMode:= MC_EXECUTION_MODE__mclmmediately ,
  Done=> bDone1 ,
  Busy=> bBusy1 ,
  Error=> bError1 ,
  ErrorID=> uwErrorID1 ,
  ProfileID=> ProfileID1
);

//-----Write data 2-----
WriteData2_1.Target := "[VAR]WriteData1_Element";
WriteData2_2.Target := "[VAR]WriteData2_Element";

//-----Profile Write 2-----
//-----Writes cam data in the PROFILE_CAM_ELEMENT type format-----
MCv_WriteProfileData_2(
  ProfileData:= ProfileData0002.ProfileData ,
  Data1:= WriteData2_1 ,
  Data2:= WriteData2_2 ,
  Execute:= bWriteProfile2 ,
  Offset:= 0 ,
  Points:= 0 ,
  Target:= 1 ,
  ExecutionMode:= MC_EXECUTION_MODE__mclmmediately ,
  Done=> bDone2 ,
  Busy=> bBusy2 ,
  Error=> bError2 ,
  ErrorID=> uwErrorID2 ,
  ProfileID=> ProfileID2
);
```

This part consists of the following chapters.

48 FUNCTION BLOCKS FOR Ethernet

---

49 FUNCTION BLOCKS FOR CC-Link IE TSN

---

# 48 FUNCTION BLOCKS FOR Ethernet

## Point

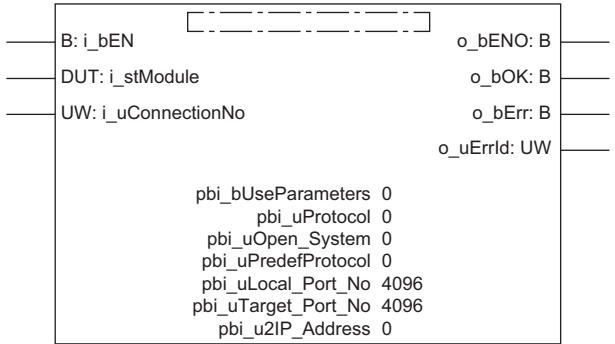
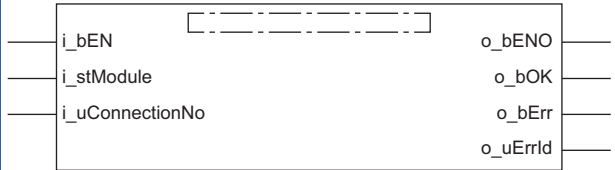
The function blocks in this chapter are controller module FBs. Use them from [Module] ⇒ [Module FB] of the Element Selection window of the engineering tool.

## 48.1 Opening/Disconnecting a Connection

### M+MXF-SQ\_ConnectionOpen

Opens (establishes) a connection.

To specify the encrypted predefined protocols (TLS and DTLS), the external device must also support them.

| Ladder                                                                                                                                                                                                       | FBD/LD                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|                                                                                                                            |  |
| ST                                                                                                                                                                                                           |                                                                                    |
| <pre>M_MXF_SQ_ConnectionOpen(   i_bEN:= ?BOOL? ,   i_stModule:= ?M+MX_SQ? ,   i_uConnectionNo:= ?WORD? ,   o_bENO=&gt; ?BOOL? ,   o_bOK=&gt; ?BOOL? ,   o_bErr=&gt; ?BOOL? ,   o_uErrId=&gt; ?WORD? );</pre> |                                                                                    |

### Setting data

#### ■Input arguments

| Variable name   | Name              | Data type                           | Range   | Description                                                                      |
|-----------------|-------------------|-------------------------------------|---------|----------------------------------------------------------------------------------|
| i_bEN           | Execution command | Bit                                 | —       | On: Start FB.<br>Off: Do not start FB.                                           |
| i_stModule      | Module label      | Structure                           | —       | Specify the module label of the controller executing the FB.<br>(Example: MX_SQ) |
| i_uConnectionNo | Connection No.    | Word [unsigned]/bit string [16-bit] | 1 to 64 | Specify the number of the connection to be opened.                               |

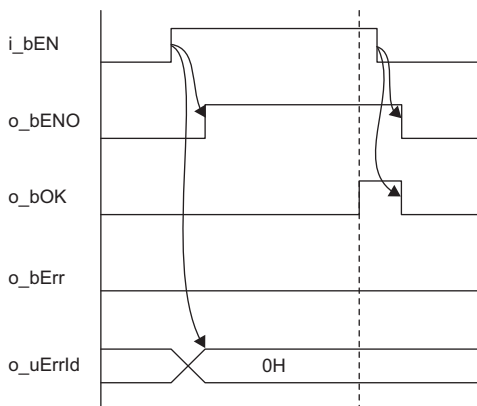
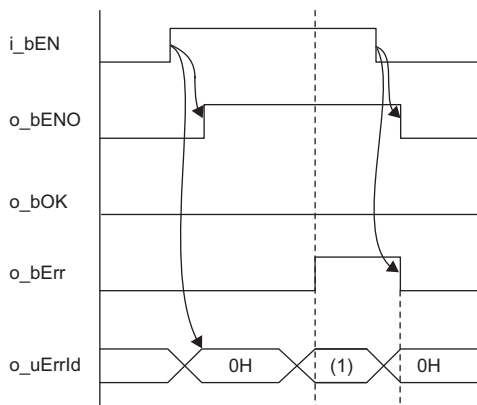
#### ■Output arguments

| Variable name | Name              | Data type                           | Description                                                                          | Default value |
|---------------|-------------------|-------------------------------------|--------------------------------------------------------------------------------------|---------------|
| o_bENO        | Execution status  | Bit                                 | On: The execution command is turned on.<br>Off: The execution command is turned off. | Off           |
| o_bOK         | Normal completion | Bit                                 | The FB has been processed normally when this argument is on.                         | Off           |
| o_bErr        | Error completion  | Bit                                 | The FB has been processed abnormally when this argument is on.                       | Off           |
| o_uErrId      | Error code        | Word [unsigned]/bit string [16-bit] | An error code is stored at error completion.                                         | 0             |

## ■Operation parameters

| Variable name       | Name                           | Data type                                  | Range                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Default value           |
|---------------------|--------------------------------|--------------------------------------------|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| pbi_bUseParameters  | Parameter used                 | Bit                                        | On or off                                           | Specify whether to use the parameter values set by the engineering tool or the following operation parameter values when processing for opening a connection.<br>• Off: Performs open processing according to the external device configuration setting made by the engineering tool. (The following operation parameters need not be set. Any settings are ignored if made.)<br>• On: Performs open processing according to the following operation parameters. | Off                     |
| pbi_uProtocol       | Protocol                       | Word [unsigned]/bit string [16-bit]        | 0 to 3                                              | Select the protocol to be used for the connection to be opened.<br>• pbi_uPredefProtocol (predefined protocol setting) is 0<br>0: TCP<br>1: UDP<br>2: TLS<br>3: DTLS<br>• pbi_uPredefProtocol (predefined protocol setting) is 1<br>0: TCP<br>1: UDP                                                                                                                                                                                                             | 0                       |
| pbi_uOpen_System    | Open method                    | Word [unsigned]/bit string [16-bit]        | 0 to 2                                              | Select the connection open method.<br>• 0: Active open or UDP or DTLS<br>• 1: Unpassive open<br>• 2: Fullpassive open                                                                                                                                                                                                                                                                                                                                            | 0                       |
| pbi_uPredefProtocol | Communication protocol setting | Word [unsigned]/bit string [16-bit]        | 0 to 1                                              | Select whether to use the predefined protocol function.<br>• 0: Do not use the predefined protocol support function. (Use the socket communications function.)<br>• 1: Use the predefined protocol support function.                                                                                                                                                                                                                                             | 0                       |
| pbi_uLocal_Port_No  | Own node port number           | Word [unsigned]/bit string [16-bit]        | 1 to 4999, 5010 to 65534                            | Specify the port number of the own node. Port numbers 1 to 1023 are generally reserved port numbers (WELL KNOWN PORT NUMBERS), and therefore port numbers 1024 to 4999 and 5010 to 65534 should be used.                                                                                                                                                                                                                                                         | 4096                    |
| pbi_uTarget_Port_No | Destination port number        | Word [unsigned]/bit string [16-bit]        | 1 to 65534, 65535                                   | Specify the destination port number. With the connection that is assigned port No.65535 (only when the UDP or DTLS protocol is selected), data is received through all port numbers. Data cannot be sent with the connection which is assigned port No.65535 and therefore a port number from 1 to 65534 should be specified to send data.                                                                                                                       | 4096                    |
| pbi_u2IP_Address    | IP address of external device  | Word [unsigned]/bit string [16-bit] (0..1) | 0.0.0.1 to 255.255.255.255 (00000001H to FFFFFFFFH) | Specify the IP address of an external device.<br>Specify the third and fourth octets to the 1st word, and first and second octets to the 2nd word.<br>Specify 255.255.255.255 (FFFFFFFH) when performing simultaneous broadcast.<br><div><div></div><div><div>b15b8b7b0</div><div>+0<div>(3)(4)</div></div><div>+1<div>(1)(2)</div></div></div><br/>(1) to (4): IP address octet</div> <td>192.168.1.1 (C0A80101H)</td>                                          | 192.168.1.1 (C0A80101H) |

## Processing details

| Item                        | Description                                                                                                                                                                                                                                                                                                     |                                      |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Available device            | Target module                                                                                                                                                                                                                                                                                                   | MELSEC MX controller (Ethernet port) |
|                             | CPU module                                                                                                                                                                                                                                                                                                      | MELSEC MX controller                 |
|                             | Engineering tool                                                                                                                                                                                                                                                                                                | GX Works3                            |
| Language                    | Ladder diagram                                                                                                                                                                                                                                                                                                  |                                      |
| Usage of labels             | Label: 36 points<br>Latched label: 0 points<br>The usage of labels embedded in a program depends on the controller used, the devices specified for arguments, and the option settings of GX Works3. For the option settings of GX Works3, refer to the following.<br><a href="#">GX Works3 Operating Manual</a> |                                      |
| Processing                  | When i_bEN (execution command) is turned on, this function opens (establishes) a connection for data communication with an external device.                                                                                                                                                                     |                                      |
| FB compilation method       | Macro type                                                                                                                                                                                                                                                                                                      |                                      |
| FB operation                | Pulse type (multiple-scan execution type)                                                                                                                                                                                                                                                                       |                                      |
| Timing chart of I/O signals | <p>• For normal completion</p>  <p>• For error completion (same as in the case of a module error)</p>  <p>(1) Error code</p>               |                                      |

| Item        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Precautions | <p>■ Specifications of the FBs</p> <ul style="list-style-type: none"> <li>• This module FB cannot be executed for the connection that is being used by another module FB or a dedicated instruction. An error occurs if this module FB is executed for the connection in use.</li> <li>• When open processing is performed according to the content of the operation parameter with pbi_bUseParameters (parameter used) set to ON, the available communication means is the socket communications and predefined protocols only.</li> <li>• If this FB is executed for the connection for which parameters are already set by "External Device Connection Configuration Setting", conduct open processing based on the operation parameters specified by this FB.</li> <li>• This FB uses the label initial value by each program. When the program file using this FB is specified to boot file setting for the boot operation in the controller, specify the initial label value file by each program to the boot file setting as well. If an error code that is not described in  Page 1989 Error codes appears, the initial label value files by each program may not be set correctly. In this case, specify the initial label value files by each program to the boot file setting.</li> <li>• When this FB is executed, an operation error may occur in the controller. In this case, check the detailed information of the operation error in event history and correct the input argument of the module FB.</li> </ul> <p>■ Operations of the FBs</p> <ul style="list-style-type: none"> <li>• Turn off i_bEN (execution command) after o_bOK (normal completion) or o_bErr (error completion) is turned on. By turning off i_bEN (execution command), o_bOK (normal completion) or o_bErr (error completion) is turned off and o_uErrId (error code) is cleared to 0.</li> </ul> |

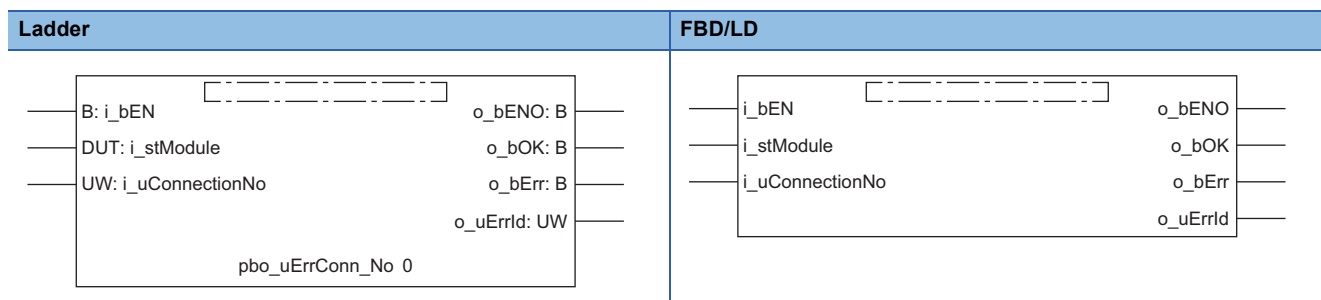
## ■ Error codes

The error code occurred by this FB is the same as the SOCOPEN instruction.

 Page 1146 GP.SOCOPEN, SP.SOCOPEN

## M+MXF-SQ\_ConnectionClose

Closes (disconnects) the connection.



### ST

```

M_MXF_SQ_ConnectionClose(
    i_bEN:= ?BOOL? ,
    i_stModule:= ?M+MX_SQ? ,
    i_uConnectionNo:= ?WORD? ,
    o_bENO=> ?BOOL? ,
    o_bOK=> ?BOOL? ,
    o_bErr=> ?BOOL? ,
    o_uErrId=> ?WORD?
);

```

### Setting data

#### Input arguments

| Variable name   | Name              | Data type                           | Range          | Description                                                                                                               |
|-----------------|-------------------|-------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------|
| i_bEN           | Execution command | Bit                                 | —              | On: Start FB.<br>Off: Do not start FB.                                                                                    |
| i_stModule      | Module label      | Structure                           | —              | Specify the module label of the controller executing the FB.<br>(Example: MX_SQ)                                          |
| i_uConnectionNo | Connection No.    | Word [unsigned]/bit string [16-bit] | 1 to 64, 65535 | Specify the number of the connection to be closed.<br>This function closes all connections if 65535 (FFFFH) is specified. |

#### Output arguments

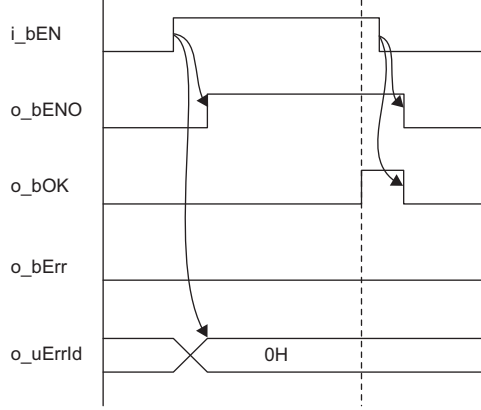
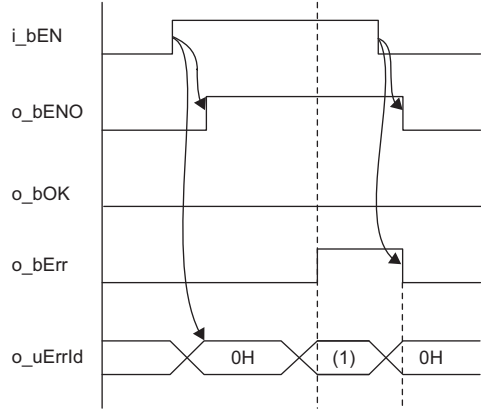
| Variable name | Name              | Data type                           | Description                                                                          | Default value |
|---------------|-------------------|-------------------------------------|--------------------------------------------------------------------------------------|---------------|
| o_bENO        | Execution status  | Bit                                 | On: The execution command is turned on.<br>Off: The execution command is turned off. | Off           |
| o_bOK         | Normal completion | Bit                                 | The FB has been processed normally when this argument is on.                         | Off           |
| o_bErr        | Error completion  | Bit                                 | The FB has been processed abnormally when this argument is on.                       | Off           |
| o_uErrId      | Error code        | Word [unsigned]/bit string [16-bit] | An error code is stored at error completion.                                         | 0             |

#### Public variables

| Variable name   | Name                 | Data type                           | Description                                                                                                                                                                                                                                                                 | Default value |
|-----------------|----------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| pbo_uErrConn_No | Error connection No. | Word [unsigned]/bit string [16-bit] | The number of the connection for which close processing was completed with an error is stored.<br>If 65535 (FFFFH) is specified in "Connection No." (i_uConnectionNo), the number of the connection for which close processing was first completed with an error is stored. | 0             |



## Processing details

| Item                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                      |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Available device            | Target module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | MELSEC MX controller (Ethernet port) |
|                             | CPU module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | MELSEC MX controller                 |
|                             | Engineering tool                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | GX Works3                            |
| Language                    | Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                      |
| Usage of labels             | Label: 28 points<br>Latched label: 0 points<br>The usage of labels embedded in a program depends on the controller used, the devices specified for arguments, and the option settings of GX Works3. For the option settings of GX Works3, refer to the following.<br><a href="#">GX Works3 Operating Manual</a>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                      |
| Processing                  | <ul style="list-style-type: none"> <li>When i_bEN (execution command) is turned on, this function closes a connection for data communication with an external device.</li> <li>The function closes all connections if 65535 (FFFFH) is specified for "Connection No." (i_uConnectionNo) in the input argument.</li> <li>If the function fails to close even one connection among those specified to be closed, it is completed with an error.</li> </ul>                                                                                                                                                                                                                                                                                                      |                                      |
| FB compilation method       | Macro type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                      |
| FB operation                | Pulse type (multiple-scan execution type)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                      |
| Timing chart of I/O signals | <ul style="list-style-type: none"> <li>For normal completion</li> </ul>  <ul style="list-style-type: none"> <li>For error completion (same as in the case of a module error)</li> </ul>  <p>(1) Error code</p>                                                                                                                                                                                                                                                                                                                                                                           |                                      |
| Precautions                 | <ul style="list-style-type: none"> <li>This module FB cannot be executed for the connection that is being used by another module FB or a dedicated instruction. An error occurs if this module FB is executed for the connection in use.</li> <li>Turn off i_bEN (execution command) after o_bOK (normal completion) or o_bErr (error completion) is turned on. By turning off i_bEN (execution command), o_bOK (normal completion) or o_bErr (error completion) is turned off and o_uErrld (error code) is cleared to 0.</li> <li>When this FB is executed, an operation error may occur in the controller. In this case, check the detailed information of the operation error in event history and correct the input argument of the module FB.</li> </ul> |                                      |

## Operation error

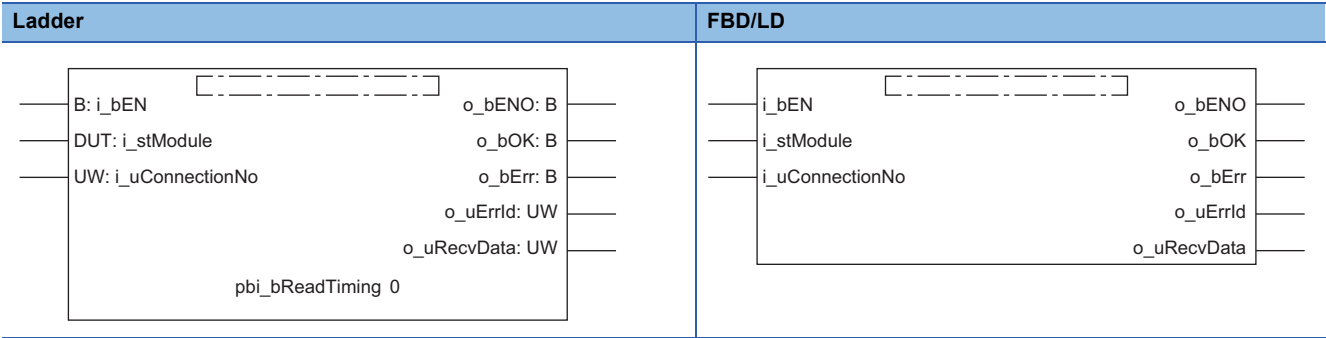
The error code occurred by this FB is the same as the SOCCLOSE instruction.

 Page 1150 GP.SOCCLOSE, SP.SOCCLOSE

# 48.2 Socket Communications

## M+MXF-SQ\_Recv\_Socket

Reads the data received from the external device through socket communications.



### ST

```
M_MXF_SQ_Recv_Socket(
    i_bEN:= ?BOOL? ,
    i_stModule:= ?M+MX_SQ? ,
    i_uConnectionNo:= ?WORD? ,
    o_bENO=> ?BOOL? ,
    o_bOK=> ?BOOL? ,
    o_bErr=> ?BOOL? ,
    o_uErrId=> ?WORD? ,
    o_uRecvData=> ?WORD?
);
```

### Setting data

#### Input arguments

| Variable name   | Name              | Data type                                 | Range   | Description                                                                      |
|-----------------|-------------------|-------------------------------------------|---------|----------------------------------------------------------------------------------|
| i_bEN           | Execution command | Bit                                       | —       | On: Start FB.<br>Off: Do not start FB.                                           |
| i_stModule      | Module label      | Structure                                 | —       | Specify the module label of the controller executing the FB.<br>(Example: MX_SQ) |
| i_uConnectionNo | Connection No.    | Word<br>[unsigned]/bit<br>string [16-bit] | 1 to 64 | Specify the number of the connection to be received.                             |

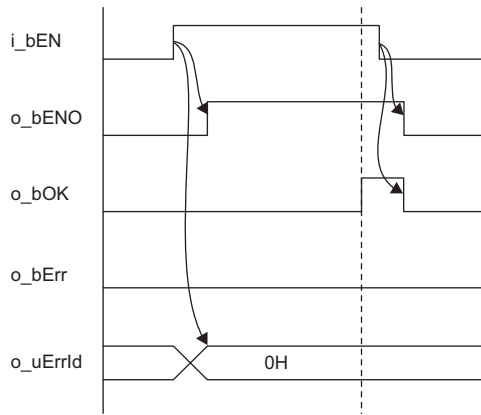
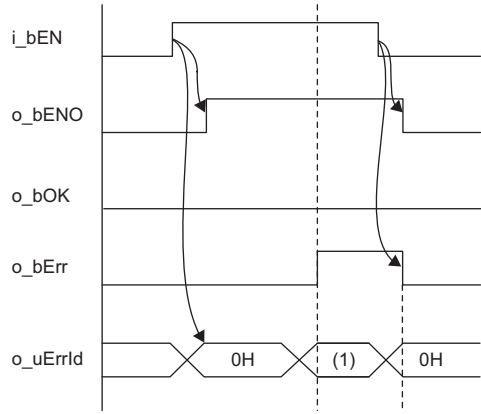
## ■Output arguments

| Variable name | Name                                | Data type                                 | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Default value |         |     |     |   |  |     |     |   |
|---------------|-------------------------------------|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------|-----|-----|---|--|-----|-----|---|
| o_bENO        | Execution status                    | Bit                                       | On: The execution command is turned on.<br>Off: The execution command is turned off.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Off           |         |     |     |   |  |     |     |   |
| o_bOK         | Normal completion                   | Bit                                       | The FB has been processed normally when this argument is on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Off           |         |     |     |   |  |     |     |   |
| o_bErr        | Error completion                    | Bit                                       | The FB has been processed abnormally when this argument is on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Off           |         |     |     |   |  |     |     |   |
| o_uErrId      | Error code                          | Word<br>[unsigned]/bit<br>string [16-bit] | An error code is stored at error completion.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0             |         |     |     |   |  |     |     |   |
| o_uRecvData   | Receive data<br>storage destination | Word<br>[unsigned]/bit<br>string [16-bit] | <p>Specify the receive data length and the start number of the device for storing received data. The data that has been read is stored sequentially in ascending order of addresses as shown below.</p> <ul style="list-style-type: none"><li>When the data unit is byte</li></ul> <p>1st word: Receive data length (unit: byte)<br/>2nd to nth word:</p> <table><tr><td>b15···b8</td><td>b7···b0</td></tr><tr><td>(2)</td><td>(1)</td></tr><tr><td colspan="2">⋮</td></tr><tr><td>(4)</td><td>(3)</td></tr></table> <p>(1) Receive data 1<br/>(2) Receive data 2<br/>(3) Receive data m-1<br/>(4) Receive data m</p> <p>The data format, unit, and data length range of receive data vary depending on the module type and connection number.<br/>Receive data is stored in the word area in order from the first half (b0 to b7) to the second half (b8 to b15).</p> <p>The following cannot be specified as an argument. Specifying any of the following may cause an error (2820H: Device/label/buffer memory specification incorrect).</p> <ul style="list-style-type: none"><li>Dynamically specified array elements (Example: wLabel[D0])</li><li>Digit-specified labels (Example: K4bLabel)</li><li>Indirectly specified devices (Example: @W0)</li><li>Local devices (Example: #D0)</li></ul> | b15···b8      | b7···b0 | (2) | (1) | ⋮ |  | (4) | (3) | 0 |
| b15···b8      | b7···b0                             |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |         |     |     |   |  |     |     |   |
| (2)           | (1)                                 |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |         |     |     |   |  |     |     |   |
| ⋮             |                                     |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |         |     |     |   |  |     |     |   |
| (4)           | (3)                                 |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |         |     |     |   |  |     |     |   |

## ■Operation parameters

| Variable name   | Name        | Data type | Range     | Description                                                                                                                                                                                                                                           | Default value |
|-----------------|-------------|-----------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| pbi_bReadTiming | Read timing | Bit       | On or off | <p>Specify the timing of executing data read processing.</p> <ul style="list-style-type: none"> <li>Off: Start reading soon after the module FB starts.</li> <li>On: Start reading in the first END processing after the module FB starts.</li> </ul> | Off           |

## Processing details

| Item                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                      |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Available device            | Target module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | MELSEC MX controller (Ethernet port) |
|                             | CPU module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | MELSEC MX controller                 |
|                             | Engineering tool                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | GX Works3                            |
| Language                    | Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                      |
| Usage of labels             | Label: 24 points<br>Latched label: 0 points<br>The usage of labels embedded in a program depends on the controller used, the devices specified for arguments, and the option settings of GX Works3. For the option settings of GX Works3, refer to the following.<br><a href="#">GX Works3 Operating Manual</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                      |
| Processing                  | When i_bEN (execution instruction) is turned on, this function reads the data received to the connection specified by the input argument.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                      |
| FB compilation method       | Macro type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                      |
| FB operation                | Pulse type (multiple-scan execution type)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                      |
| Timing chart of I/O signals | <p>• For normal completion</p>  <p>• For error completion (same as in the case of a module error)</p>  <p>(1) Error code</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                      |
| Precautions                 | <ul style="list-style-type: none"> <li>This module FB cannot be executed for the connection that is being used by another module FB or a dedicated instruction. An error occurs if this module FB is executed for the connection in use.</li> <li>Turn off i_bEN (execution command) after o_bOK (normal completion) or o_bErr (error completion) is turned on. By turning off i_bEN (execution command), o_bOK (normal completion) or o_bErr (error completion) is turned off and o_uErrld (error code) is cleared to 0.</li> <li>The execution command of this FB can be executed at any timing. However, when executing it after receiving data, G7889 to G7892 (Socket communications reception status signal) or corresponding module label must be added to conditions of the execution.</li> <li>When the module FB is executed by specifying ON (start reading in the first END processing after the FB starts) in operation parameter "Read timing", the module FB extends the scan time to complete data read processing within one END processing.</li> <li>This FB uses the label initial value by each program. When the program file using this FB is specified to boot file setting for the boot operation in the controller, specify the initial label value file by each program to the boot file setting as well. If an error code that is not described in <a href="#">Page 1995 Error codes</a> appears, the initial label value files by each program may not be set correctly. In this case, specify the initial label value files by each program to the boot file setting.</li> <li>When this FB is executed, an operation error may occur in the controller. In this case, check the detailed information of the operation error in event history and correct the input argument of the module FB.</li> </ul> |                                      |

## ■Error codes

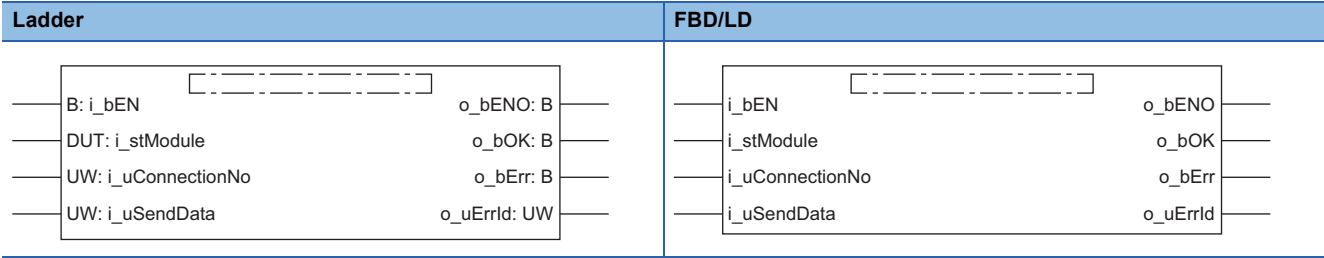
The error code occurred by this FB is the same as the SOCRCV instruction or SOCRCVS instruction.

☞ Page 1152 GP.SOCRCV, SP.SOCRCV

☞ Page 1157 G.SOCRCVS, S.SOCRCVS

M+MXF-SQ\_Send\_Socket

Sends data to the external device through socket communications.



ST

```
M_MXF_SQ_Send_Socket(  
  i_bEN:= ?BOOL? ,  
  i_stModule:= ?M+MX_SQ? ,  
  i_uConnectionNo:= ?WORD? ,  
  i_uSendData:= ?WORD? ,  
  o_bENO=> ?BOOL? ,  
  o_bOK=> ?BOOL? ,  
  o_bErr=> ?BOOL? ,  
  o_uErrId=> ?WORD?  
);
```

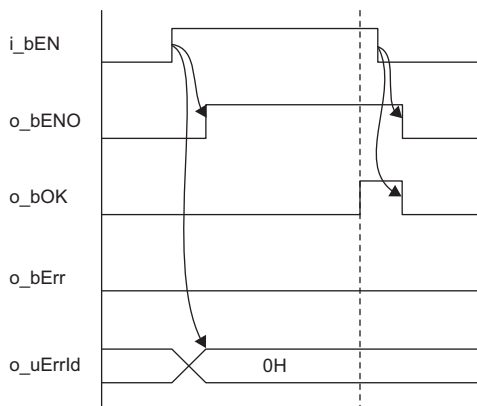
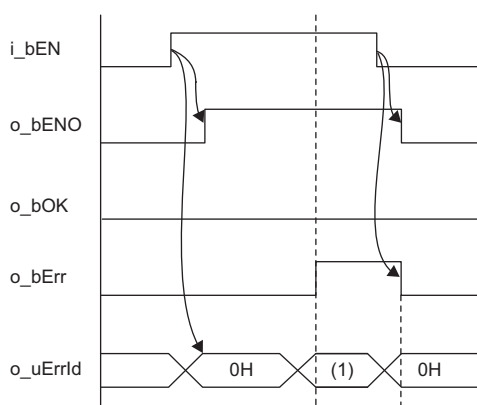
## Input arguments

| Variable name   | Name                          | Data type                           | Range   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |         |     |     |   |  |     |     |
|-----------------|-------------------------------|-------------------------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------|-----|-----|---|--|-----|-----|
| i_bEN           | Execution command             | Bit                                 | —       | On: Start FB.<br>Off: Do not start FB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |         |     |     |   |  |     |     |
| i_stModule      | Module label                  | Structure                           | —       | Specify the module label of the controller executing the FB.<br>(Example: MX_SQ)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |         |     |     |   |  |     |     |
| i_uConnectionNo | Connection No.                | Word [unsigned]/bit string [16-bit] | 1 to 64 | Specify the number of the connection to be sent.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |         |     |     |   |  |     |     |
| i_uSendData     | Send data storage destination | Word [unsigned]/bit string [16-bit] | —       | <p>Specify the start number of the device containing the send data length and data to be sent.</p> <ul style="list-style-type: none"><li>When the data unit is byte</li></ul> <p>1st word: Send data length (unit: byte)<br/>2nd to nth word:</p> <table><tr><td>b15···b8</td><td>b7···b0</td></tr><tr><td>(2)</td><td>(1)</td></tr><tr><td colspan="2">:</td></tr><tr><td>(4)</td><td>(3)</td></tr></table> <p>(1) Send data 1<br/>(2) Send data 2<br/>(3) Send data m-1<br/>(4) Send data m</p> <p>The data format and data length range of send data vary depending on the module type and the setting of the connection used.</p> <p>Data is sent in the word area in order from the first half (b0 to b7) to the second half (b8 to b15).</p> <p>The following cannot be specified as an argument. Specifying any of the following may cause an error (2820H: Device/label/buffer memory specification incorrect).</p> <ul style="list-style-type: none"><li>Dynamically specified array elements (Example: wLabel[D0])</li><li>Digit-specified labels (Example: K4bLabel)</li><li>Indirectly specified devices (Example: @W0)</li><li>Local devices (Example: #D0)</li></ul> | b15···b8 | b7···b0 | (2) | (1) | : |  | (4) | (3) |
| b15···b8        | b7···b0                       |                                     |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |         |     |     |   |  |     |     |
| (2)             | (1)                           |                                     |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |         |     |     |   |  |     |     |
| :               |                               |                                     |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |         |     |     |   |  |     |     |
| (4)             | (3)                           |                                     |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |         |     |     |   |  |     |     |

## Output arguments

| Variable name | Name              | Data type                           | Description                                                                          | Default value |
|---------------|-------------------|-------------------------------------|--------------------------------------------------------------------------------------|---------------|
| o_bENO        | Execution status  | Bit                                 | On: The execution command is turned on.<br>Off: The execution command is turned off. | Off           |
| o_bOK         | Normal completion | Bit                                 | The FB has been processed normally when this argument is on.                         | Off           |
| o_bErr        | Error completion  | Bit                                 | The FB has been processed abnormally when this argument is on.                       | Off           |
| o_uErrId      | Error code        | Word [unsigned]/bit string [16-bit] | An error code is stored at error completion.                                         | 0             |

## Processing details

| Item                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                      |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Available device            | Target module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | MELSEC MX controller (Ethernet port) |
|                             | CPU module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | MELSEC MX controller                 |
|                             | Engineering tool                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | GX Works3                            |
| Language                    | Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                      |
| Usage of labels             | Label: 24 points<br>Latched label: 0 points<br>The usage of labels embedded in a program depends on the controller used, the devices specified for arguments, and the option settings of GX Works3. For the option settings of GX Works3, refer to the following.<br><a href="#">GX Works3 Operating Manual</a>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                      |
| Processing                  | When i_bEN (execution instruction) is turned on, this function sends the data to the external device of the connection specified by the input argument.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                      |
| FB compilation method       | Macro type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                      |
| FB operation                | Pulse type (multiple-scan execution type)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                      |
| Timing chart of I/O signals | <p>• For normal completion</p>  <p>• For error completion (same as in the case of a module error)</p>  <p>(1) Error code</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                      |
| Precautions                 | <ul style="list-style-type: none"> <li>This module FB cannot be executed for the connection that is being used by another module FB or a dedicated instruction. An error occurs if this module FB is executed for the connection in use.</li> <li>Turn off i_bEN (execution command) after o_bOK (normal completion) or o_bErr (error completion) is turned on. By turning off i_bEN (execution command), o_bOK (normal completion) or o_bErr (error completion) is turned off and o_uErrId (error code) is cleared to 0.</li> <li>When this FB is executed, an operation error may occur in the controller. In this case, check the detailed information of the operation error in event history and correct the input argument of the module FB.</li> </ul> |                                      |

## Operation error

The error code occurred by this FB is the same as the SOCSND instruction.

 Page 1160 GP.SOCSND, SP.SOCSND



## M+MXF-SQ\_SLMP\_DeviceRead\_IP

Reads device data from the SLMP-compatible device specified by an IP address.

The external device must support SLMP command (Device Read).

For encrypted communications, the external device must support the encrypted predefined protocol (DTLS) in addition to the above.

| Ladder                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | FBD/LD                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div><div></div><div><div>B: i_bEN</div><div>DUT: i_stModule</div><div>UW: i_u2IP_Address</div><div>UW: i_uSubCommand</div><div>UW: i_uDeviceCode</div><div>UW: i_u2DeviceNo</div><div>UW: i_uDevicePoints</div><div>UW: i_uChannel</div><div>UW: i_uTarget_Port_No</div></div><div><div>o_bENO: B</div><div>o_bOK: B</div><div>o_bErr: B</div><div>o_uErrId: UW</div><div>o_uReadData:UW</div></div><div><div>pbi_uRequestModuleIO H3FF</div><div>pbi_uResendCountMax 0</div><div>pbi_uMonitorTime 0</div><div>pbi_bEncryptionComm 0</div><div>pbi_uLocal_Port_No 4096</div><div>pbo_uResendCount 0</div><div>pbo_u4ErrTime 0</div><div>pbo_uErrIP_Address_3rd_4th 0</div><div>pbo_uErrIP_Address_1st_2nd 0</div></div></div> | <div><div></div><div><div>i_bEN</div><div>i_stModule</div><div>i_u2IP_Address</div><div>i_uSubCommand</div><div>i_uDeviceCode</div><div>i_u2DeviceNo</div><div>i_uDevicePoints</div><div>i_uChannel</div><div>i_uTarget_Port_No</div></div><div><div>o_bENO</div><div>o_bOK</div><div>o_bErr</div><div>o_uErrId</div><div>o_uReadData</div></div></div> |

| ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>M_MXF_SQ_SLMP_DeviceRead_IP(<br/>  i_bEN:= ?BOOL? ,<br/>  i_stModule:= ?M+MX_SQ? ,<br/>  i_u2IP_Address:= ?WORD(0..1)? ,<br/>  i_uSubCommand:= ?WORD? ,<br/>  i_uDeviceCode:= ?WORD? ,<br/>  i_u2DeviceNo:= ?WORD(0..1)? ,<br/>  i_uDevicePoints:= ?WORD? ,<br/>  i_uChannel:= ?WORD? ,<br/>  i_uTarget_Port_No:= ?WORD? ,<br/>  o_bENO=&gt; ?BOOL? ,<br/>  o_bOK=&gt; ?BOOL? ,<br/>  o_bErr=&gt; ?BOOL? ,<br/>  o_uErrId=&gt; ?WORD? ,<br/>  o_uReadData=&gt; ?WORD?<br/>);</pre> |

## Setting data

### Input arguments

| Variable name     | Name                          | Data type                                         | Range                                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |
|-------------------|-------------------------------|---------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----|----|----|----|----|-----|--|--|-----|----|-----|--|--|-----|
| i_bEN             | Execution command             | Bit                                               | —                                                      | On: Start FB.<br>Off: Do not start FB.                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |
| i_stModule        | Module label                  | Structure                                         | —                                                      | Specify the module label of the controller executing the FB.<br>(Example: MX_SQ)                                                                                                                                                                                                                                                                                                                                                                                                      |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |
| i_u2IP_Address    | IP address of external device | Word [unsigned]/<br>bit string [16-bit]<br>(0..1) | 0.0.0.1 to 253.255.255.254<br>(00000001H to DFFFFFFEH) | Specify the IP address of an external device.<br>Specify the third and fourth octets to the 1st word, and first and second octets to the 2nd word.<br>Note that the fourth octet cannot be set to 0 or 255 (FFH).<br><br><table border="1"> <tr> <td></td><td>b15</td><td>b8</td><td>b7</td><td>b0</td></tr> <tr> <td>+0</td><td>(3)</td><td></td><td></td><td>(4)</td></tr> <tr> <td>+1</td><td>(1)</td><td></td><td></td><td>(2)</td></tr> </table><br>(1) to (4): IP address octet |  | b15 | b8 | b7 | b0 | +0 | (3) |  |  | (4) | +1 | (1) |  |  | (2) |
|                   | b15                           | b8                                                | b7                                                     | b0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |
| +0                | (3)                           |                                                   |                                                        | (4)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |
| +1                | (1)                           |                                                   |                                                        | (2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |
| i_uSubCommand     | Sub command                   | Word [unsigned]/<br>bit string [16-bit]           | —                                                      | Specify the read unit and specification method of a device.<br><b>0th bit:</b> Read unit<br>0: In units of words<br>1: In units of bits<br><b>1st bit:</b> Specification method of the device is read<br>0: Specify the device code in 2 digits and the start device number in 6 digits (for MELSEC-Q/L series).<br>1: Specify the device code in 4 digits and the start device number in 8 digits (for MELSEC iQ-R series).                                                          |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |
| i_uDeviceCode     | Device code <sup>*1</sup>     | Word [unsigned]/<br>bit string [16-bit]           | —                                                      | Specify the device code of the device to be read in binary code.<br><ul style="list-style-type: none"> <li>When the 1st bit of the subcommand is 0: 2 digits</li> <li>When the 1st bit of the subcommand is 1: 4 digits</li> </ul>                                                                                                                                                                                                                                                    |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |
| i_u2DeviceNo      | Head device No.               | Word [unsigned]/<br>bit string [16-bit]<br>(0..1) | —                                                      | Specify the start device number of the device to be read in binary code.<br><ul style="list-style-type: none"> <li>When the 1st bit of the subcommand is 0: 6 digits</li> <li>When the 1st bit of the subcommand is 1: 8 digits</li> </ul>                                                                                                                                                                                                                                            |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |
| i_uDevicePoints   | Number of device points       | Word [unsigned]/<br>bit string [16-bit]           | —                                                      | Specify the number of device points of the device to be read in binary code.<br><ul style="list-style-type: none"> <li>When the 0th bit of the subcommand is 0: 1 to 960</li> <li>When the 0th bit of the subcommand is 1: 1 to 3972</li> </ul>                                                                                                                                                                                                                                       |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |
| i_uChannel        | Own station channel           | Word [unsigned]/<br>bit string [16-bit]           | 1 to 9                                                 | Specify the channel to be used by the own station.<br>Since whether or not a serial number <sup>*2</sup> is given to the request message depends on the channel, specify the channel as follows according to the application.<br><ul style="list-style-type: none"> <li>1: No serial number is given (3E frame used)</li> <li>2 to 9: Serial number is given (4E frame used)</li> </ul>                                                                                               |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |
| i_uTarget_Port_No | Destination port number       | Word [unsigned]/<br>bit string [16-bit]           | 1 to 65534                                             | Specify the UDP port number or DTLS port number of an external device.                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |    |    |    |    |     |  |  |     |    |     |  |  |     |

\*1 For details on each device code, refer to the following.

SLMP Reference Manual

\*2 Give the serial numbers when sending several request messages to the same SLMP-compatible device. Serial numbers to be given are automatically numbered by the system. For the serial number, refer to the following.

SLMP Reference Manual

## ■Output arguments

| Variable name | Name                          | Data type                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Default value |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|-------------------------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---|---|---|-----|--|--|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| o_bENO        | Execution status              | Bit                                     | On: The execution command is turned on.<br>Off: The execution command is turned off.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Off           |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| o_bOK         | Normal completion             | Bit                                     | The FB has been processed normally when this argument is on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Off           |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| o_bErr        | Error completion              | Bit                                     | The FB has been processed abnormally when this argument is on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Off           |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| o_uErrId      | Error code                    | Word [unsigned]/<br>bit string [16-bit] | An error code is stored at error completion.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0             |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| o_uReadData   | Read data storage destination | Word [unsigned]/<br>bit string [16-bit] | <p>Specify the start device number of the device for storing the read data. The read data is stored in binary code.</p> <p>■When the 0th bit of the subcommand is 0<br/>The device data is read in units of words.<br/>Example: When reading the bit device M100 to M115 (one word) in units of words<br/>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td colspan="4">...</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr></table><div>M115...M100</div></div> <p>Example: When reading the word device D0 to D2 in units of words<br/>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr></table><div>D0</div></div> <p>2nd word:</p> <div><div>b15b8b7b0</div><table><tr><td>0</td><td>0</td><td>0</td><td>2</td></tr></table><div>D1</div></div> <p>3rd word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>D</td><td>E</td><td>F</td></tr></table><div>D2</div></div> <p>■When the 0th bit of the subcommand is 1<br/>The device data is read in units of bits.<br/>Example: When reading the bit device M100 to M107 in units of bits<br/>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>0</td><td>1</td><td>0</td><td>0</td></tr></table><div>M102M103M100M101</div></div> <p>2nd word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>1</td><td>0</td><td>0</td></tr></table><div>M106M107M104M105</div></div> | 1             | 2 | 3 | 4 | ... |  |  |  | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 3 | 4 | 0 | 0 | 0 | 2 | 1 | D | E | F | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 1             | 2                             | 3                                       | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| ...           |                               |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 0                                       | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1             | 2                             | 3                                       | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 0                                       | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1             | D                             | E                                       | F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 1                             | 0                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1             | 1                             | 0                                       | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

## ■Operation parameters

| Variable name        | Name                                   | Data type                           | Range                    | Description                                                                                                                                                                                                                                                                                                                         | Default value |
|----------------------|----------------------------------------|-------------------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| pbi_uRequestModuleIO | Requested module I/O No.               | Word [unsigned]/bit string [16-bit] | 03E0H to 03E3H, 03FFH    | Specify the module of the access destination.<br><ul style="list-style-type: none"> <li>• 03FFH: Own station, control CPU</li> <li>• 03E0H: Multiple CPU No.1</li> <li>• 03E1H: Multiple CPU No.2</li> <li>• 03E2H: Multiple CPU No.3</li> <li>• 03E3H: Multiple CPU No.4</li> </ul>                                                | 03FFH         |
| pbi_uResendCountMax  | Maximum number of resends              | Word [unsigned]/bit string [16-bit] | 0 to 15                  | Specify the number of resends to be performed if the data transfer is not completed within the monitoring time specified by pbi_uMonitorTime (Arrival monitoring time).<br><ul style="list-style-type: none"> <li>• 0 to 15</li> </ul>                                                                                              | 5             |
| pbi_uMonitorTime     | Arrival monitoring time                | Word [unsigned]/bit string [16-bit] | 0, 1 to 32767            | Specify the monitoring time until completion of processing. If the processing is not completed within the monitoring time, data is resent until the value specified in pbi_uResendCountMax (Maximum number of resends) is reached.<br><ul style="list-style-type: none"> <li>• 0: 10s</li> <li>• 1 to 32767: 1 to 32767s</li> </ul> | 0             |
| pbi_bEncryptionComm  | Encrypted communication enable/disable | Bit string                          | On or off                | Specify whether SLMP frames are encrypted or not.<br><ul style="list-style-type: none"> <li>• On: Enable (Encrypt)</li> <li>• Off: Disable (Do not encrypt)</li> </ul>                                                                                                                                                              | Off           |
| pbi_uLocal_Port_No   | Own node port number                   | Word [unsigned]/bit string [16-bit] | 1 to 4999, 5010 to 65534 | Specify the port number of the own node. Port numbers 1 to 1023 are generally reserved port numbers (WELL KNOWN PORT NUMBERS), and therefore port numbers 1024 to 4999 and 5010 to 65534 should be used.<br>The specified value is valid only when pbi_bEncryptionComm (whether to use the encrypted communications) is ON.         | 4096          |

## ■Public variables

| Variable name              | Name                                                           | Data type                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Default value |
|----------------------------|----------------------------------------------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| pbo_uResendCount           | Number of resends                                              | Word [unsigned]/bit string [16-bit]        | The number of resends performed (result) is stored.<br>The number of resends performed (result) between error detection and resend stop is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0             |
| pbo_u4ErrTime              | Error occurrence time                                          | Word [unsigned]/bit string [16-bit] (0..3) | Clock data at the time of error occurrence is stored.<br>1st word<br><ul style="list-style-type: none"> <li>• Upper 8 bits: Month (01H to 12H)</li> <li>• Lower 8 bits: Lower 2 digits of year (00H to 99H)</li> </ul> 2nd word<br><ul style="list-style-type: none"> <li>• Upper 8 bits: Hour (00H to 23H)</li> <li>• Lower 8 bits: Day (01H to 31H)</li> </ul> 3rd word<br><ul style="list-style-type: none"> <li>• Upper 8 bits: Second (00H to 59H)</li> <li>• Lower 8 bits: Minute (00H to 59H)</li> </ul> 4th word<br><ul style="list-style-type: none"> <li>• Upper 8 bits: Upper 2 digits of year (00H to 99H)</li> <li>• Lower 8 bits: Day of week (00H (Sunday) to 06H (Saturday))</li> </ul> | 0             |
| pbo_uErrIP_Address_3rd_4th | IP address of error detected station (third and fourth octets) | Word [unsigned]/bit string [16-bit] (0..1) | The IP addresses (the third and fourth octets) of the station in which an error was detected are stored.*1<br>Example: When the IP address is 192.168.1.2<br>0102h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0             |
| pbo_uErrIP_Address_1st_2nd | IP address of error detected station (first and second octets) | Word [unsigned]/bit string [16-bit] (0..1) | The IP addresses (the first and second octets) of the station in which an error was detected are stored.*1<br>Example: When the IP address is 192.168.1.2<br>C0A8h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0             |

\*1 The value is stored only when the dedicated instruction was completed with an error.

The value set to the target station address of the input argument is stored in the error-detected device IP addresses (the third and fourth octets) and the error-detected device IP addresses (the first and second octets).

## Processing details

| Item                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Available device      | Target module<br>MELSEC MX controller (Ethernet port)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                       | CPU module<br>MELSEC MX controller                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                       | Engineering tool<br>GX Works3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Language              | Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Usage of labels       | <p>Label: 1096 points<br/>Latched label: 0 points</p> <p>The usage of labels embedded in a program depends on the controller used, the devices specified for arguments, and the option settings of GX Works3. For the option settings of GX Works3, refer to the following.</p> <p> GX Works3 Operating Manual</p>                                                                                                                                                                                                                                                                                                                                                |
| Processing            | <ul style="list-style-type: none"> <li>• When i_bEN (execution command) is turned on, this function reads device data from the SLMP-compatible device.</li> <li>• Execute this FB while the IP address for an external device is specified.</li> <li>• This FB uses Read command (command: 0401) of the SLMP. The message of the SLMP command is a binary code. ( SLMP Reference Manual)</li> <li>• When pbi_bEncryptionComm (whether to use the encrypted communications) is turned on and this FB is executed, the port number specified in pbi_uLocal_Port_No (own node port number) is used for communication by SLMP frame encrypted with DTLS.</li> </ul> |
| FB compilation method | Macro type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| FB operation          | Pulse type (multiple-scan execution type)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

| Item                        | Description                                                                                                                                                                                                                      |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Timing chart of I/O signals | <ul style="list-style-type: none"> <li>For normal completion</li> </ul>                                                                                                                                                          |
|                             | <ul style="list-style-type: none"> <li>For error completion (When the dedicated instruction was completed with an error)</li> </ul> <p>(1) Error code<br/>(2) Error occurrence time<br/>(3) Error-detected device IP address</p> |
|                             | <ul style="list-style-type: none"> <li>For error completion (When the dedicated instruction was completed successfully but the end code indicates an error)</li> </ul> <p>(1) Error code</p>                                     |
|                             |                                                                                                                                                                                                                                  |

| Item        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Precautions | <ul style="list-style-type: none"> <li>This FB does not include error recovery processing. Please create error recovery processing separately according to the system and required operations.</li> <li>This FB uses the SLMPSND instruction or SLMPSNDC instruction. The SLMPSND instruction and SLMPSNDC instruction are successfully completed even if the target device returns an abnormal response. Therefore, in this FB, the instruction is determined to be completed successfully or completed with an error by the end code of the response frame in addition to the completion status of the dedicated instruction. If the instruction is determined as completed with an error by the end code, check that the end code is stored in o_uErrId (error code), and 0 (initial value) is stored in pbo_u4ErrTime (error occurrence time), pbo_uErrIP_Address_3rd_4th (error detection device IP address (3rd and 4th octets)) and pbo_uErrIP_Address_1st_2nd (error detection device IP address (1st and 2nd octets)). For the cause of the error, refer the manual for the SLMP-compatible device being used, and take corrective action. (SLMP Reference Manual)</li> <li>Turn off i_bEN (execution command) after o_bOK (normal completion) or o_bErr (error completion) is turned on. By turning off i_bEN (execution command), o_bOK (normal completion) or o_bErr (error completion) is turned off and o_uErrId (error code) is cleared to 0.</li> <li>In this FB, access devices (such as link direct device) that are accessed by the extension specification of the SLMP cannot be read.</li> <li>In this FB, stations in other network cannot be set as the target station.</li> <li>When this FB is executed for the port of an external device where the remote password is set, execute this FB after performing the unlock processing of the remote password. When this FB is executed for the port of an external device where the remote password is set, an error will occur.</li> <li>The target station must support "Read (command: 0401)" of the SLMP command.</li> <li>This FB is for communications in binary code only. (Communications using ASCII code cannot be performed.)</li> <li>This FB uses UDP or DTLS communications. The external device must have the same settings.</li> <li>This FB uses the label initial value by each program. When the program file using this FB is specified to boot file setting for the boot operation in the controller, specify the initial label value file by each program to the boot file setting as well. If an error code that is not described in  Page 2005 Error codes appears, the initial label value files by each program may not be set correctly. In this case, specify the initial label value files by each program to the boot file setting.</li> <li>When pbi_bEncryptionComm (whether to use the encrypted communications) is on (enabled), the value set to pbi_uLocal_Port_No (own node port number) must not be the same as the value set to "PLC Port No." set in "External Device Configuration" in the module parameter (Ethernet). If the configured port numbers are overlapped, this FB may complete with an error.</li> <li>When this FB is executed, an operation error may occur in the controller. In this case, check the detailed information of the operation error in event history and correct the input argument of the module FB.</li> </ul> |

## ■Error codes

| Error code  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                     | Action                                                                                   |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 100H        | A value out of the range is set in the number of device points (i_uDevicePoints) of the argument.                                                                                                                                                                                                                                                                                                                                               | Set the value within the setting range in the number of device points (i_uDevicePoints). |
| Except 100H | <p>Check the error code of the SLMPSND instruction and take actions.</p> <p> Page 1184 G(P).SLMPSND, J(P).SLMPSND, SP.SLMPSND</p> <p>For encrypted communication, check the error code of the SLMPSNDC instruction, and take actions.</p> <p> Page 1194 G(P).SLMPSNDC</p> |                                                                                          |

# M+MXF-SQ\_SLMP\_DeviceWrite\_IP

Writes device data to the SLMP-compatible device specified by an IP address.  
The external device must support SLMP command (Device Write).  
For encrypted communications, the external device must support the encrypted predefined protocol (DTLS) in addition to the above.

| Ladder                                                                                                                                                                                                                                                                                                                                                                                                        | FBD/LD                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div><div></div><div><div>B: i_bEN</div><div>DUT: i_stModule</div><div>UW: i_u2IP_Address</div><div>UW: i_uSubCommand</div><div>UW: i_uDeviceCode</div><div>UW: i_u2DeviceNo</div><div>UW: i_uDevicePoints</div><div>UW: i_uWriteData</div><div>UW: i_uChannel</div><div>UW: i_uTarget_Port_No</div></div><div><div>o_bENO: B</div><div>o_bOK: B</div><div>o_bErr: B</div><div>o_uErrId: UW</div></div></div> | <div><div></div><div><div>i_bEN</div><div>i_stModule</div><div>i_u2IP_Address</div><div>i_uSubCommand</div><div>i_uDeviceCode</div><div>i_u2DeviceNo</div><div>i_uDevicePoints</div><div>i_uWriteData</div><div>i_uChannel</div><div>i_uTarget_Port_No</div></div><div><div>o_bENO</div><div>o_bOK</div><div>o_bErr</div><div>o_uErrId</div></div></div> |

| ST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>M_MXF_SQ_SLMP_DeviceWrite_IP(<br/>  i_bEN:= ?BOOL? ,<br/>  i_stModule:= ?M+MX_SQ? ,<br/>  i_u2IP_Address:= ?WORD(0..1)? ,<br/>  i_uSubCommand:= ?WORD? ,<br/>  i_uDeviceCode:= ?WORD? ,<br/>  i_u2DeviceNo:= ?WORD(0..1)? ,<br/>  i_uDevicePoints:= ?WORD? ,<br/>  i_uWriteData:= ?WORD? ,<br/>  i_uChannel:= ?WORD? ,<br/>  i_uTarget_Port_No:= ?WORD? ,<br/>  o_bENO=&gt; ?BOOL? ,<br/>  o_bOK=&gt; ?BOOL? ,<br/>  o_bErr=&gt; ?BOOL? ,<br/>  o_uErrId=&gt; ?WORD?<br/>);</div> |



## ■ Input arguments

| Variable name   | Name                          | Data type                                        | Range                                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
|-----------------|-------------------------------|--------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----|----|----|----|----|-----|--|-----|--|----|-----|--|-----|--|
| i_bEN           | Execution command             | Bit                                              | —                                                      | On: Start FB.<br>Off: Do not start FB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_stModule      | Module label                  | Structure                                        | —                                                      | Specify the module label of the controller executing the FB.<br>(Example: MX_SQ)                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_u2IP_Address  | IP address of external device | Word<br>[unsigned]/bit string [16-bit]<br>(0..1) | 0.0.0.1 to 253.255.255.254<br>(00000001H to DFFFFFFEH) | Specify the IP address of the target station.<br>Specify the third and fourth octets to the 1st word, and first and second octets to the 2nd word.<br>Note that the fourth octet cannot be set to 0 or 255 (FFH).<br><br><div style="text-align: center;"> <table> <tr> <td></td><td>b15</td><td>b8</td><td>b7</td><td>b0</td></tr> <tr> <td>+0</td><td>(3)</td><td></td><td>(4)</td><td></td></tr> <tr> <td>+1</td><td>(1)</td><td></td><td>(2)</td><td></td></tr> </table> </div><br>(1) to (4): IP address octet |  | b15 | b8 | b7 | b0 | +0 | (3) |  | (4) |  | +1 | (1) |  | (2) |  |
|                 | b15                           | b8                                               | b7                                                     | b0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| +0              | (3)                           |                                                  | (4)                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| +1              | (1)                           |                                                  | (2)                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_uSubCommand   | Sub command                   | Word<br>[unsigned]/bit string [16-bit]           | —                                                      | Specify the write unit and specification method of a device.<br><b>0th bit:</b> Write unit<br>0: In units of words<br>1: In units of bits<br><b>Specification method of the device is written</b><br>0: Specify the device code in 2 digits and the start device number in 6 digits (for MELSEC-Q/L series).<br>1: Specify the device code in 4 digits and the start device number in 8 digits (for MELSEC iQ-R series).                                                                                            |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_uDeviceCode   | Device code*1                 | Word<br>[unsigned]/bit string [16-bit]           | —                                                      | Specify the device code of the device to be written in binary code.<br><ul style="list-style-type: none"> <li>When the 1st bit of the subcommand is 0: 2 digits</li> <li>When the 1st bit of the subcommand is 1: 4 digits</li> </ul>                                                                                                                                                                                                                                                                               |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_u2DeviceNo    | Head device No.               | Word<br>[unsigned]/bit string [16-bit]<br>(0..1) | —                                                      | Specify the start device number of the device to be written in binary code.<br><ul style="list-style-type: none"> <li>When the 1st bit of the subcommand is 0: 6 digits</li> <li>When the 1st bit of the subcommand is 1: 8 digits</li> </ul>                                                                                                                                                                                                                                                                       |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_uDevicePoints | Number of device points       | Word<br>[unsigned]/bit string [16-bit]           | —                                                      | Specify the number of device points of the device to be written in binary code.<br><ul style="list-style-type: none"> <li>When the 0th bit of the subcommand is 0: 1 to 960</li> <li>When the 0th bit of the subcommand is 1: 1 to 3972</li> </ul>                                                                                                                                                                                                                                                                  |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |

| Variable name     | Name                           | Data type                           | Range      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------------|--------------------------------|-------------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| i_uWriteData      | Write data storage destination | Word [unsigned]/bit string [16-bit] | —          | <p>Specify the start device number of the device for storing the write data.</p> <p>■When the 0th bit of the subcommand is 0</p> <p>The device data is written in units of words.</p> <p>Example: When writing the bit device M100 to M115 (one word) in units of words</p> <p>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr></table><div>M115...M100</div></div> <p>Example: When writing the word device D0 to D2 in units of words</p> <p>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr></table><div>D0</div></div> <p>2nd word:</p> <div><div>b15b8b7b0</div><table><tr><td>0</td><td>0</td><td>0</td><td>2</td></tr></table><div>D1</div></div> <p>3rd word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>D</td><td>E</td><td>F</td></tr></table><div>D2</div></div> <p>■When the 0th bit of the subcommand is 1</p> <p>The device data is written in units of bits.</p> <p>Example: When writing the bit device M100 to M107 in units of bits</p> <p>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>0</td><td>1</td><td>0</td><td>0</td></tr></table><div>M102M103M100M101</div></div> <p>2nd word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>1</td><td>0</td><td>0</td></tr></table><div>M106M107M104M105</div></div> | 1 | 2 | 3 | 4 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 3 | 4 | 0 | 0 | 0 | 2 | 1 | D | E | F | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1                 | 2                              | 3                                   | 4          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 0                                   | 1          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 1                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 1                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 1                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 1                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 1                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 1                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                 | 2                              | 3                                   | 4          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 0                                   | 2          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                 | D                              | E                                   | F          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 1                              | 0                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                 | 1                              | 0                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| i_uChannel        | Own station channel            | Word [unsigned]/bit string [16-bit] | 1 to 9     | <p>Specify the channel to be used by the own station.</p> <p>Since whether or not a serial number<sup>*2</sup> is given to the request message depends on the channel, specify the channel as follows according to the application.</p> <ul style="list-style-type: none"><li>• 1: No serial number is given (3E frame used)</li><li>• 2 to 9: Serial number is given (4E frame used)</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| i_uTarget_Port_No | Destination port number        | Word [unsigned]/bit string [16-bit] | 1 to 65534 | <p>Specify the UDP port number or DTLS port number of an external device.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

\*1 For details on each device code, refer to the following.

📖 SLMP Reference Manual

\*2 Give the serial numbers when sending several request messages to the same SLMP-compatible device. Serial numbers to be given are automatically numbered by the system. For the serial number, refer to the following.

📖 SLMP Reference Manual

## ■Output arguments

| Variable name | Name              | Data type                           | Description                                                                          | Default value |
|---------------|-------------------|-------------------------------------|--------------------------------------------------------------------------------------|---------------|
| o_bENO        | Execution status  | Bit                                 | On: The execution command is turned on.<br>Off: The execution command is turned off. | Off           |
| o_bOK         | Normal completion | Bit                                 | The FB has been processed normally when this argument is on.                         | Off           |
| o_bErr        | Error completion  | Bit                                 | The FB has been processed abnormally when this argument is on.                       | Off           |
| o_uErrId      | Error code        | Word [unsigned]/bit string [16-bit] | An error code is stored at error completion.                                         | 0             |

## ■Operation parameters

| Variable name        | Name                                   | Data type                           | Range                    | Description                                                                                                                                                                                                                                                                                                                 | Default value |
|----------------------|----------------------------------------|-------------------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| pbi_uRequestModuleIO | Requested module I/O No.               | Word [unsigned]/bit string [16-bit] | 03E0H to 03E3H, 03FFH    | Specify the module of the access destination.<br>• 03FFH: Own station, control CPU<br>• 03E0H: Multiple CPU No.1<br>• 03E1H: Multiple CPU No.2<br>• 03E2H: Multiple CPU No.3<br>• 03E3H: Multiple CPU No.4                                                                                                                  | 03FFH         |
| pbi_uResendCountMax  | Maximum number of resends              | Word [unsigned]/bit string [16-bit] | 0 to 15                  | Specify the number of resends to be performed if the data transfer is not completed within the monitoring time specified by pbi_uMonitorTime (Arrival monitoring time).<br>• 0 to 15                                                                                                                                        | 5             |
| pbi_uMonitorTime     | Arrival monitoring time                | Word [unsigned]/bit string [16-bit] | 0, 1 to 32767            | Specify the monitoring time until completion of processing. If the processing is not completed within the monitoring time, data is resent until the value specified in pbi_uResendCountMax (Maximum number of resends) is reached.<br>• 0: 10s<br>• 1 to 32767: 1 to 32767s                                                 | 0             |
| pbi_bEncryptionComm  | Encrypted communication enable/disable | Bit string                          | On or off                | Specify whether SLMP frames are encrypted or not.<br>• On: Enable (Encrypt)<br>• Off: Disable (Do not encrypt)                                                                                                                                                                                                              | Off           |
| pbi_uLocal_Port_No   | Own node port number                   | Word [unsigned]/bit string [16-bit] | 1 to 4999, 5010 to 65534 | Specify the port number of the own node. Port numbers 1 to 1023 are generally reserved port numbers (WELL KNOWN PORT NUMBERS), and therefore port numbers 1024 to 4999 and 5010 to 65534 should be used.<br>The specified value is valid only when pbi_bEncryptionComm (whether to use the encrypted communications) is ON. | 4096          |

## ■Public variables

| Variable name              | Name                                                           | Data type                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Default value |
|----------------------------|----------------------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| pbo_uResendCount           | Number of resends                                              | Word [unsigned]/bit string [16-bit]        | The number of resends performed (result) is stored.                                                                                                                                                                                                                                                                                                                                                                                                                              | 0             |
| pbo_u4ErrTime              | Error occurrence time                                          | Word [unsigned]/bit string [16-bit] (0..3) | Clock data at the time of error occurrence is stored.<br>1st word<br>• Upper 8 bits: Month (01H to 12H)<br>• Lower 8 bits: Lower 2 digits of year (00H to 99H)<br>2nd word<br>• Upper 8 bits: Hour (00H to 23H)<br>• Lower 8 bits: Day (01H to 31H)<br>3rd word<br>• Upper 8 bits: Second (00H to 59H)<br>• Lower 8 bits: Minute (00H to 59H)<br>4th word<br>• Upper 8 bits: Upper 2 digits of year (00H to 99H)<br>• Lower 8 bits: Day of week (00H (Sunday) to 06H (Saturday)) | 0             |
| pbo_uErrIP_Address_3rd_4th | IP address of error detected station (third and fourth octets) | Word [unsigned]/bit string [16-bit] (0..1) | The IP addresses (the third and fourth octets) of the station in which an error was detected are stored.*1<br>Example: When the IP address is 192.168.1.2<br>0102h                                                                                                                                                                                                                                                                                                               | 0             |
| pbo_uErrIP_Address_1st_2nd | IP address of error detected station (first and second octets) | Word [unsigned]/bit string [16-bit] (0..1) | The IP addresses (the first and second octets) of the station in which an error was detected are stored.*1<br>Example: When the IP address is 192.168.1.2<br>C0A8h                                                                                                                                                                                                                                                                                                               | 0             |

\*1 The value is stored only when the dedicated instruction was completed with an error.  
The value set to the target station address of the input argument is stored in the error-detected device IP addresses (the third and fourth octets) and the error-detected device IP addresses (the first and second octets).

## Processing details

| Item                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Available device      | Target module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                       | CPU module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                       | Engineering tool                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Language              | Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Usage of labels       | Label: 1096 points<br>Latched label: 0 points<br>The usage of labels embedded in a program depends on the controller used, the devices specified for arguments, and the option settings of GX Works3. For the option settings of GX Works3, refer to the following.<br> GX Works3 Operating Manual                                                                                                                                                                                                                                                                                                                                                      |
| Processing            | <ul style="list-style-type: none"> <li>When i_bEN (execution command) is turned on, this function writes device data of the SLMP-compatible device.</li> <li>Execute this FB while the IP address for an external device is specified.</li> <li>This FB uses Write command (command: 1401) of the SLMP. The message of the SLMP command is a binary code. ( SLMP Reference Manual)</li> <li>When pbi_bEncryptionComm (whether to use the encrypted communications) is turned on and this FB is executed, the port number specified in pbi_uLocal_Port_No (own node port number) is used for communication by SLMP frame encrypted with DTLS.</li> </ul> |
| FB compilation method | Macro type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| FB operation          | Pulse type (multiple-scan execution type)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Item                        | Description                                                                                                                                                                                                                        |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Timing chart of I/O signals | <ul style="list-style-type: none"> <li>For normal completion</li> </ul>                                                                                                                                                            |
|                             | <ul style="list-style-type: none"> <li>For error completion (When the dedicated instruction was completed with an error)</li> </ul> <p>(1) Error code<br/> (2) Error occurrence time<br/> (3) Error-detected device IP address</p> |
|                             | <ul style="list-style-type: none"> <li>For error completion (When the dedicated instruction was completed successfully but the end code indicates an error)</li> </ul> <p>(1) Error code</p>                                       |

| Item        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Precautions | <ul style="list-style-type: none"> <li>This FB does not include error recovery processing. Please create error recovery processing separately according to the system and required operations.</li> <li>This FB uses the SLMPSEND instruction or SLMPSENDNC instruction. The SLMPSEND instruction and SLMPSENDNC instruction are successfully completed even if the target device returns an abnormal response. Therefore, in this FB, the instruction is determined to be completed successfully or completed with an error by the end code of the response frame in addition to the completion status of the dedicated instruction. If the instruction is determined as completed with an error by the end code, check that the end code is stored in o_uErrId (error code), and 0 (initial value) is stored in pbo_u4ErrTime (error occurrence time), pbo_uErrIP_Address_3rd_4th (error detection device IP address (3rd and 4th octets)) and pbo_uErrIP_Address_1st_2nd (error detection device IP address (1st and 2nd octets)). For the cause of the error, refer the manual for the SLMP-compatible device being used, and take corrective action. (SLMP Reference Manual)</li> <li>Turn off i_bEN (execution command) after o_bOK (normal completion) or o_bErr (error completion) is turned on. By turning off i_bEN (execution command), o_bOK (normal completion) or o_bErr (error completion) is turned off and o_uErrId (error code) is cleared to 0.</li> <li>In this FB, access devices (such as link direct device) that are accessed by the extension specification of the SLMP cannot be written.</li> <li>In this FB, stations in other network cannot be set as the target station.</li> <li>When this FB is executed for the port of an external device where the remote password is set, execute this FB after performing the unlock processing of the remote password. When this FB is executed for the port of an external device where the remote password is set, an error will occur.</li> <li>The target station must support "Write (command: 1401)" of the SLMP command.</li> <li>This FB is for communications in binary code only. (Communications using ASCII code cannot be performed.)</li> <li>This FB uses UDP or DTLS communications. The external device must have the same settings.</li> <li>This FB uses the label initial value by each program. When the program file using this FB is specified to boot file setting for the boot operation in the controller, specify the initial label value file by each program to the boot file setting as well. If an error code that is not described in  Page 2012 Error codes appears, the initial label value files by each program may not be set correctly. In this case, specify the initial label value files by each program to the boot file setting.</li> <li>When pbi_bEncryptionComm (whether to use the encrypted communications) is on (enabled), the value set to pbi_uLocal_Port_No (own node port number) must not be the same as the value set to "PLC Port No." set in "External Device Configuration" in the module parameter (Ethernet). If the configured port numbers are overlapped, this FB may complete with an error.</li> <li>When this FB is executed, an operation error may occur in the controller. In this case, check the detailed information of the operation error in event history and correct the input argument of the module FB.</li> </ul> |

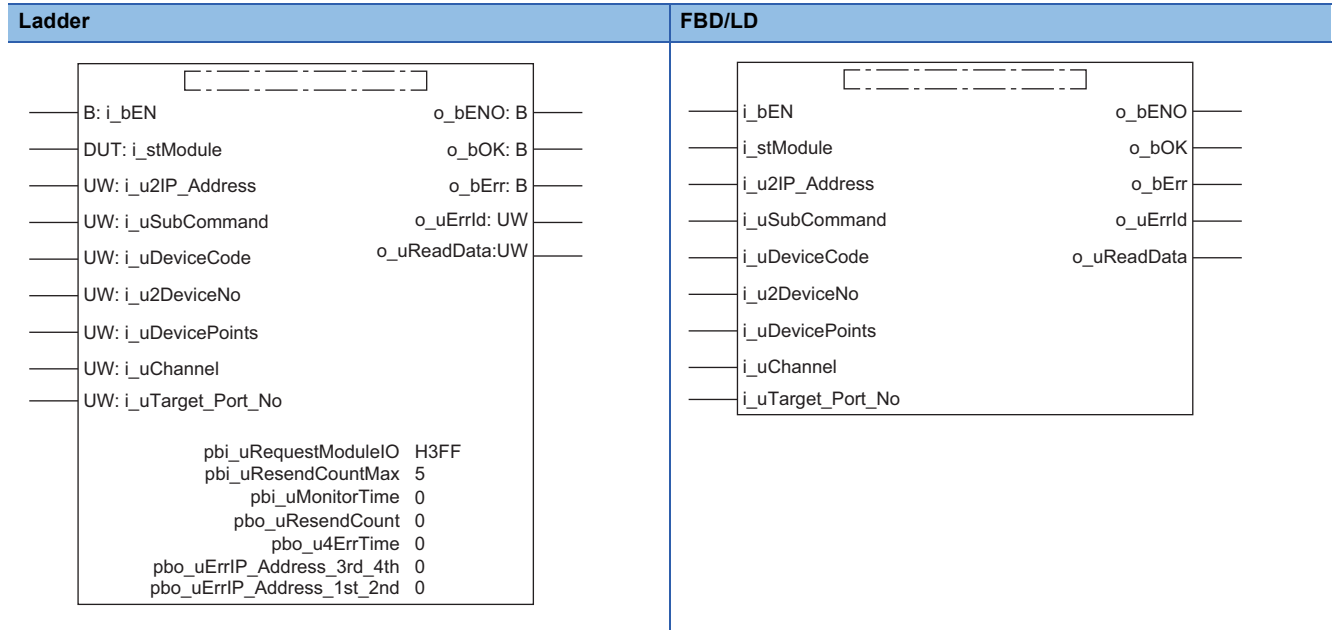
## ■Error codes

| Error code  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                             | Action                                                                                   |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 100H        | A value out of the range is set in the number of device points (i_uDevicePoints) of the argument.                                                                                                                                                                                                                                                                                                                                                       | Set the value within the setting range in the number of device points (i_uDevicePoints). |
| Except 100H | <p>Check the error code of the SLMPSEND instruction and take actions.</p> <p> Page 1184 G(P).SLMPSEND, J(P).SLMPSEND, SP.SLMPSEND</p> <p>For encrypted communication, check the error code of the SLMPSENDNC instruction, and take actions.</p> <p> Page 1194 G(P).SLMPSENDNC</p> |                                                                                          |

## M+MXF-TSN\_SLMP\_DeviceRead\_IP

Reads device data from the SLMP-compatible device specified by an IP address.

The external device must support SLMP command (Device Read).



### ST

```

M_MXF_TSN_SLMP_DeviceRead_IP(
  i_bEN:= ?BOOL? ,
  i_stModule:= ?M+MX_TSN? ,
  i_u2IP_Address:= ?WORD(0..1)? ,
  i_uSubCommand:= ?WORD? ,
  i_uDeviceCode:= ?WORD? ,
  i_u2DeviceNo:= ?WORD(0..1)? ,
  i_uDevicePoints:= ?WORD? ,
  i_uChannel:= ?WORD? ,
  i_uTarget_Port_No:= ?WORD? ,
  o_bENO=> ?BOOL? ,
  o_bOK=> ?BOOL? ,
  o_bErr=> ?BOOL? ,
  o_uErrId=> ?WORD? ,
  o_uReadData=> ?WORD?
);

```

## Setting data

### Input arguments

| Variable name     | Name                          | Data type                                        | Range                                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------|-------------------------------|--------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| i_bEN             | Execution command             | Bit                                              | —                                                      | On: Start FB.<br>Off: Do not start FB.                                                                                                                                                                                                                                                                                                                                                                           |
| i_stModule        | Module label                  | Structure                                        | —                                                      | Specify the module label of the controller executing the FB.<br>(Example: MX_TSN)                                                                                                                                                                                                                                                                                                                                |
| i_u2IP_Address    | IP address of external device | Word<br>[unsigned]/bit string [16-bit]<br>(0..1) | 0.0.0.1 to 253.255.255.254<br>(00000001H to DFFFFFFEH) | Specify the IP address of an external device.<br>Specify the third and fourth octets to the 1st word, and first and second octets to the 2nd word.<br>Note that the fourth octet cannot be set to 0 or 255 (FFH).<br><div><div><div>b15b8b7b0</div><div>+0<div>(3)(4)</div></div><div>+1<div>(1)(2)</div></div></div><br/>(1) to (4): IP address octet</div>                                                     |
| i_uSubCommand     | Sub command                   | Word<br>[unsigned]/bit string [16-bit]           | —                                                      | Specify the read unit and specification method of a device.<br>■0th bit: Read unit<br>0: In units of words<br>1: In units of bits<br>■1st bit: Specification method of the device is read<br>0: Specify the device code in 2 digits and the start device number in 6 digits (for MELSEC-Q/L series).<br>1: Specify the device code in 4 digits and the start device number in 8 digits (for MELSEC iQ-R series). |
| i_uDeviceCode     | Device code*1                 | Word<br>[unsigned]/bit string [16-bit]           | —                                                      | Specify the device code of the device to be read in binary code.<br>• When the 1st bit of the subcommand is 0: 2 digits<br>• When the 1st bit of the subcommand is 1: 4 digits                                                                                                                                                                                                                                   |
| i_u2DeviceNo      | Head device No.               | Word<br>[unsigned]/bit string [16-bit]<br>(0..1) | —                                                      | Specify the start device number of the device to be read in binary code.<br>• When the 1st bit of the subcommand is 0: 6 digits<br>• When the 1st bit of the subcommand is 1: 8 digits                                                                                                                                                                                                                           |
| i_uDevicePoints   | Number of device points       | Word<br>[unsigned]/bit string [16-bit]           | —                                                      | Specify the number of device points of the device to be read in binary code.<br>• When the 0th bit of the subcommand is 0: 1 to 960<br>• When the 0th bit of the subcommand is 1: 1 to 3972                                                                                                                                                                                                                      |
| i_uChannel        | Own station channel           | Word<br>[unsigned]/bit string [16-bit]           | 1 to 9                                                 | Specify the channel to be used by the own station.<br>• 1: No serial number is given (3E frame used)<br>• 2 to 9: Serial number is given (4E frame used)<br>• 10 to 17: Station number extension frame                                                                                                                                                                                                           |
| i_uTarget_Port_No | Destination port number       | Word<br>[unsigned]/bit string [16-bit]           | 1 to 65534                                             | Specify the UDP port number of an external device.                                                                                                                                                                                                                                                                                                                                                               |

\*1 For details on each device code, refer to the following.

 SLMP Reference Manual



## ■Output arguments

| Variable name | Name                          | Data type                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Default value |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|-------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---|---|---|-----|--|--|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| o_bENO        | Execution status              | Bit                                 | On: The execution command is turned on.<br>Off: The execution command is turned off.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Off           |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| o_bOK         | Normal completion             | Bit                                 | The FB has been processed normally when this argument is on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Off           |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| o_bErr        | Error completion              | Bit                                 | The FB has been processed abnormally when this argument is on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Off           |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| o_uErrId      | Error code                    | Word [unsigned]/bit string [16-bit] | An error code is stored at error completion.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0             |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| o_uReadData   | Read data storage destination | Word [unsigned]/bit string [16-bit] | <p>Specify the start device number of the device for storing the read data. The read data is stored in binary code.</p> <p>■When the 0th bit of the subcommand is 0<br/>The device data is read in units of words.<br/>Example: When reading the bit device M100 to M115 (one word) in units of words<br/>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td colspan="4">...</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td></tr></table><div>M115...M100</div></div> <p>Example: When reading the word device D0 to D2 in units of words<br/>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr></table><div>D0</div></div> <p>2nd word:</p> <div><div>b15b8b7b0</div><table><tr><td>0</td><td>0</td><td>0</td><td>2</td></tr></table><div>D1</div></div> <p>3rd word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>D</td><td>E</td><td>F</td></tr></table><div>D2</div></div> <p>■When the 0th bit of the subcommand is 1<br/>The device data is read in units of bits.<br/>Example: When reading the bit device M100 to M107 in units of bits<br/>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>0</td><td>1</td><td>0</td><td>0</td></tr></table><div>M102M103M100M101</div></div> <p>2nd word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>1</td><td>0</td><td>0</td></tr></table><div>M106M107M104M105</div></div> | 1             | 2 | 3 | 4 | ... |  |  |  | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 2 | 3 | 4 | 0 | 0 | 0 | 2 | 1 | D | E | F | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 1             | 2                             | 3                                   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| ...           |                               |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 0                                   | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 1                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 0                                   | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 1                             | 0                                   | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 1                             | 0                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1             | 2                             | 3                                   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 0                             | 0                                   | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1             | D                             | E                                   | F                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0             | 1                             | 0                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1             | 1                             | 0                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

## ■Operation parameters

| Variable name        | Name                      | Data type                           | Range                 | Description                                                                                                                                                                                                                                                                                                                         | Default value |
|----------------------|---------------------------|-------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| pbi_uRequestModuleIO | Requested module I/O No.  | Word [unsigned]/bit string [16-bit] | 03E0H to 03E3H, 03FFH | Specify the module of the access destination.<br><ul style="list-style-type: none"> <li>• 03FFH: Own station, control CPU</li> <li>• 03E0H: Multiple CPU No.1</li> <li>• 03E1H: Multiple CPU No.2</li> <li>• 03E2H: Multiple CPU No.3</li> <li>• 03E3H: Multiple CPU No.4</li> </ul>                                                | 03FFH         |
| pbi_uResendCountMax  | Maximum number of resends | Word [unsigned]/bit string [16-bit] | 0 to 15               | Specify the number of resends to be performed if the data transfer is not completed within the monitoring time specified by pbi_uMonitorTime (Arrival monitoring time).<br><ul style="list-style-type: none"> <li>• 0 to 15</li> </ul>                                                                                              | 5             |
| pbi_uMonitorTime     | Arrival monitoring time   | Word [unsigned]/bit string [16-bit] | 0, 1 to 32767         | Specify the monitoring time until completion of processing. If the processing is not completed within the monitoring time, data is resent until the value specified in pbi_uResendCountMax (Maximum number of resends) is reached.<br><ul style="list-style-type: none"> <li>• 0: 10s</li> <li>• 1 to 32767: 1 to 32767s</li> </ul> | 0             |

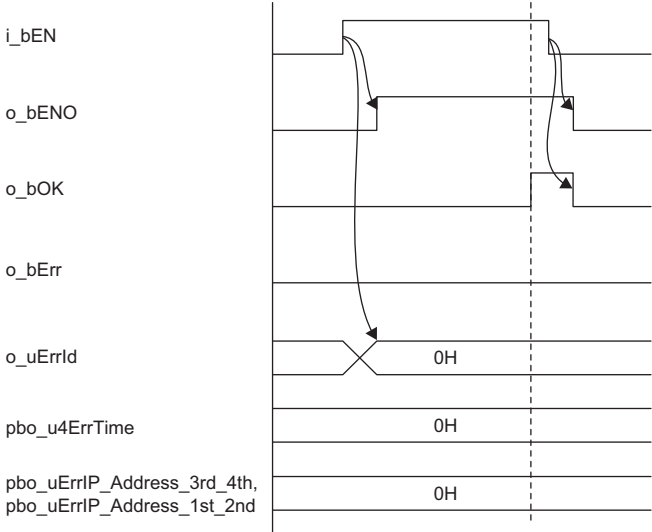
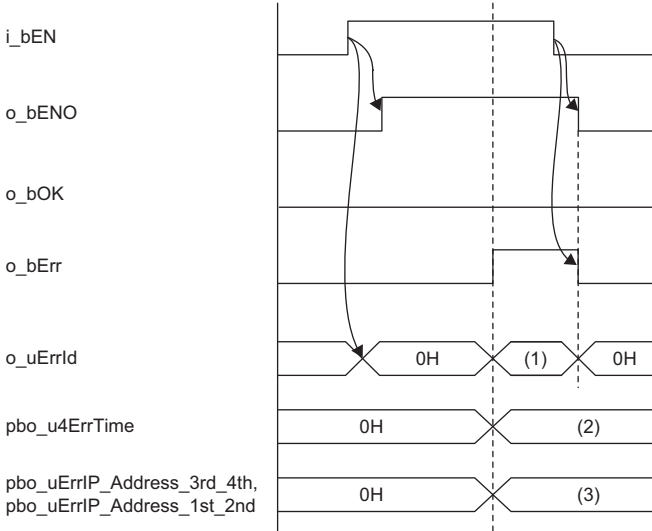
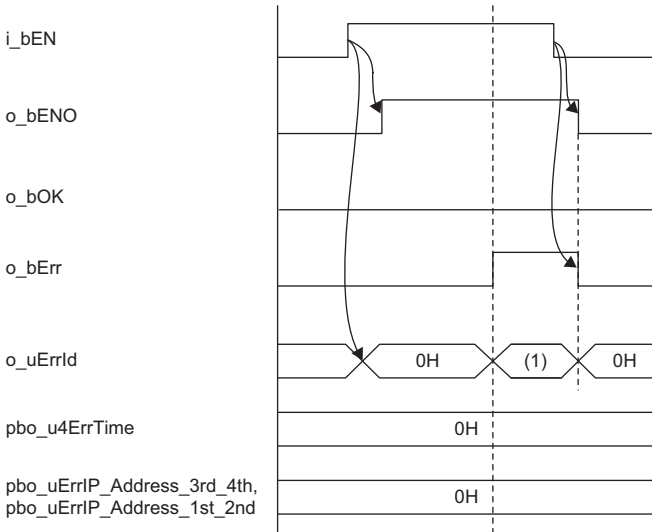
## ■Public variables

| Variable name              | Name                                                           | Data type                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Default value |
|----------------------------|----------------------------------------------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| pbo_uResendCount           | Number of resends                                              | Word [unsigned]/bit string [16-bit]        | The number of resends performed (result) is stored.<br>The number of resends performed (result) between error detection and resend stop is stored.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0             |
| pbo_u4ErrTime              | Error occurrence time                                          | Word [unsigned]/bit string [16-bit] (0..3) | Clock data at the time of error occurrence is stored.<br>1st word<br><ul style="list-style-type: none"> <li>• Upper 8 bits: Month (01H to 12H)</li> <li>• Lower 8 bits: Lower 2 digits of year (00H to 99H)</li> </ul> 2nd word<br><ul style="list-style-type: none"> <li>• Upper 8 bits: Hour (00H to 23H)</li> <li>• Lower 8 bits: Day (01H to 31H)</li> </ul> 3rd word<br><ul style="list-style-type: none"> <li>• Upper 8 bits: Second (00H to 59H)</li> <li>• Lower 8 bits: Minute (00H to 59H)</li> </ul> 4th word<br><ul style="list-style-type: none"> <li>• Upper 8 bits: Upper 2 digits of year (00H to 99H)</li> <li>• Lower 8 bits: Day of week (00H (Sunday) to 06H (Saturday))</li> </ul> | 0             |
| pbo_uErrIP_Address_3rd_4th | IP address of error detected station (third and fourth octets) | Word [unsigned]/bit string [16-bit] (0..1) | The IP addresses (the third and fourth octets) of the station in which an error was detected are stored.*1<br>Example: When the IP address is 192.168.1.2<br>0102h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0             |
| pbo_uErrIP_Address_1st_2nd | IP address of error detected station (first and second octets) | Word [unsigned]/bit string [16-bit] (0..1) | The IP addresses (the first and second octets) of the station in which an error was detected are stored.*1<br>Example: When the IP address is 192.168.1.2<br>C0A8h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0             |

\*1 The value is stored only when the dedicated instruction was completed with an error.

The value set to the target station address of the input argument is stored in the error-detected device IP addresses (the third and fourth octets) and the error-detected device IP addresses (the first and second octets).

| Item                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Available device      | Target module                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | MELSEC MX controller (port for CC-Link IE TSN) |
|                       | CPU module                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | MELSEC MX controller                           |
|                       | Engineering tool                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | GX Works3                                      |
| Language              | Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                |
| Usage of labels       | Label: 1076 points<br>Latched label: 0 points<br>The usage of labels embedded in a program depends on the controller used, the devices specified for arguments, and the option settings of GX Works3. For the option settings of GX Works3, refer to the following.<br> GX Works3 Operating Manual                                                                                              |                                                |
| Processing            | <ul style="list-style-type: none"> <li>When i_bEN (execution command) is turned on, this function reads device data from the SLMP-compatible device.</li> <li>Execute this FB while the IP address for an external device is specified.</li> <li>This FB uses Read command (command: 0401) of the SLMP. The message of the SLMP command is a binary code. ( SLMP Reference Manual)</li> </ul> |                                                |
| FB compilation method | Macro type                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                |
| FB operation          | Pulse type (multiple-scan execution type)                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                |

| Item                        | Description                                                                                                                                                                                                                                                                                                            |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Timing chart of I/O signals | <ul style="list-style-type: none"> <li>For normal completion</li> </ul>                                                                                                                                                              |
|                             | <ul style="list-style-type: none"> <li>For error completion (When the dedicated instruction was completed with an error)</li> </ul>  <p>(1) Error code<br/> (2) Error occurrence time<br/> (3) Error-detected device IP address</p> |
|                             | <ul style="list-style-type: none"> <li>For error completion (When the dedicated instruction was completed successfully but the end code indicates an error)</li> </ul>  <p>(1) Error code</p>                                      |
|                             |                                                                                                                                                                                                                                                                                                                        |

| Item        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Precautions | <ul style="list-style-type: none"> <li>This FB does not include error recovery processing. Please create error recovery processing separately according to the system and required operations.</li> <li>This FB uses the SLMPSEND instruction. The SLMPSEND instruction is successfully completed even if the target device returns an abnormal response. Therefore, in this FB, the instruction is determined to be completed successfully or completed with an error by the end code of the response frame in addition to the completion status of the dedicated instruction. If the instruction is determined as completed with an error by the end code, check that the end code is stored in o_uErrId (error code), and 0 (initial value) is stored in pbo_u4ErrTime (error occurrence time), pbo_uErrIP_Address_3rd_4th (error detection device IP address (3rd and 4th octets)) and pbo_uErrIP_Address_1st_2nd (error detection device IP address (1st and 2nd octets)). For the cause of the error, refer the manual for the SLMP-compatible device being used, and take corrective action. (SLMP Reference Manual)</li> <li>Turn off i_bEN (execution command) after o_bOK (normal completion) or o_bErr (error completion) is turned on. By turning off i_bEN (execution command), o_bOK (normal completion) or o_bErr (error completion) is turned off and o_uErrId (error code) is cleared to 0.</li> <li>In this FB, access devices (such as link direct device) that are accessed by the extension specification of the SLMP cannot be read.</li> <li>In this FB, stations in other network cannot be set as the target station.</li> <li>When this FB is executed for the port of an external device where the remote password is set, execute this FB after performing the unlock processing of the remote password. When this FB is executed for the port of an external device where the remote password is set, an error will occur.</li> <li>The target station must support "Read (command: 0401)" of the SLMP command.</li> <li>This FB is for communications in binary code only. (Communications using ASCII code cannot be performed.)</li> <li>This FB uses UDP communications. The external device must have the same settings.</li> <li>This FB uses the label initial value by each program. When the program file using this FB is specified to boot file setting for the boot operation in the controller, specify the initial label value file by each program to the boot file setting as well. If an error code that is not described in Page 2019 Error codes appears, the initial label value files by each program may not be set correctly. In this case, specify the initial label value files by each program to the boot file setting.</li> <li>When this FB is executed, an operation error may occur in the controller. In this case, check the detailed information of the operation error in event history and correct the input argument of the module FB.</li> </ul> |

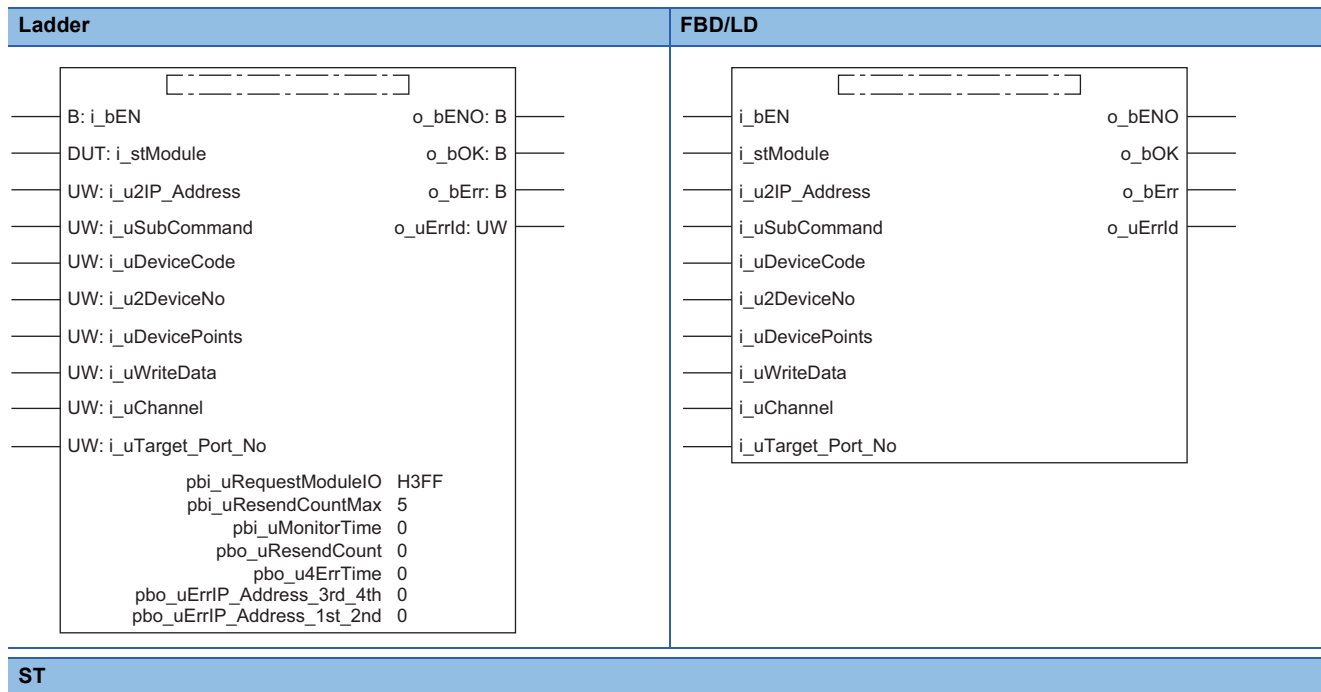
## ■Error codes

| Error code  | Description                                                                                                               | Action                                                                                   |
|-------------|---------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 100H        | A value out of the range is set in the number of device points (i_uDevicePoints) of the argument.                         | Set the value within the setting range in the number of device points (i_uDevicePoints). |
| Except 100H | Check the error code of the SLMPSEND instruction and take actions.<br>Page 1184 G(P).SLMPSEND, J(P).SLMPSEND, SP.SLMPSEND |                                                                                          |

## M+MXF-TSN\_SLMP\_DeviceWrite\_IP

Writes device data to the SLMP-compatible device specified by an IP address.

The external device must support SLMP command (Device Write).



### ST

```

M_MXF_TSN_SLMP_DeviceWrite_IP(
    i_bEN:= ?BOOL? ,
    i_stModule:= ?M+MX_TSN? ,
    i_u2IP_Address:= ?WORD(0..1)? ,
    i_uSubCommand:= ?WORD? ,
    i_uDeviceCode:= ?WORD? ,
    i_u2DeviceNo:= ?WORD(0..1)? ,
    i_uDevicePoints:= ?WORD? ,
    i_uWriteData:= ?WORD? ,
    i_uChannel:= ?WORD? ,
    i_uTarget_Port_No:= ?WORD? ,
    o_bENO=> ?BOOL? ,
    o_bOK=> ?BOOL? ,
    o_bErr=> ?BOOL? ,
    o_uErrId=> ?WORD?
);

```

## ■Input arguments

| Variable name   | Name                          | Data type                                  | Range                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
|-----------------|-------------------------------|--------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----|----|----|----|----|-----|--|-----|--|----|-----|--|-----|--|
| i_bEN           | Execution command             | Bit                                        | —                                                   | On: Start FB.<br>Off: Do not start FB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_stModule      | Module label                  | Structure                                  | —                                                   | Specify the module label of the controller executing the FB.<br>(Example: MX_TSN)                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_u2IP_Address  | IP address of external device | Word [unsigned]/bit string [16-bit] (0..1) | 0.0.0.1 to 253.255.255.254 (00000001H to DFFFFFFEH) | Specify the IP address of the target station.<br>Specify the third and fourth octets to the 1st word, and first and second octets to the 2nd word.<br>Note that the fourth octet cannot be set to 0 or 255 (FFH).<br><br><div style="text-align: center;"> <table> <tr> <td></td><td>b15</td><td>b8</td><td>b7</td><td>b0</td></tr> <tr> <td>+0</td><td colspan="2">(3)</td><td colspan="2">(4)</td></tr> <tr> <td>+1</td><td colspan="2">(1)</td><td colspan="2">(2)</td></tr> </table> </div><br>(1) to (4): IP address octet |  | b15 | b8 | b7 | b0 | +0 | (3) |  | (4) |  | +1 | (1) |  | (2) |  |
|                 | b15                           | b8                                         | b7                                                  | b0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| +0              | (3)                           |                                            | (4)                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| +1              | (1)                           |                                            | (2)                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_uSubCommand   | Sub command                   | Word [unsigned]/bit string [16-bit]        | —                                                   | Specify the write unit and specification method of a device.<br><b>0th bit:</b> Write unit<br>0: In units of words<br>1: In units of bits<br><b>Specification method of the device is written</b><br>0: Specify the device code in 2 digits and the start device number in 6 digits (for MELSEC-Q/L series).<br>1: Specify the device code in 4 digits and the start device number in 8 digits (for MELSEC iQ-R series).                                                                                                        |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_uDeviceCode   | Device code*1                 | Word [unsigned]/bit string [16-bit]        | —                                                   | Specify the device code of the device to be written in binary code.<br>• When the 1st bit of the subcommand is 0: 2 digits<br>• When the 1st bit of the subcommand is 1: 4 digits                                                                                                                                                                                                                                                                                                                                               |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_u2DeviceNo    | Head device No.               | Word [unsigned]/bit string [16-bit] (0..1) | —                                                   | Specify the start device number of the device to be written in binary code.<br>• When the 1st bit of the subcommand is 0: 6 digits<br>• When the 1st bit of the subcommand is 1: 8 digits                                                                                                                                                                                                                                                                                                                                       |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |
| i_uDevicePoints | Number of device points       | Word [unsigned]/bit string [16-bit]        | —                                                   | Specify the number of device points of the device to be written in binary code.<br><b>When the 0th bit of the subcommand is 0</b><br>• 1 to 960<br><b>When the 0th bit of the subcommand is 1: 1 to 3972</b><br>• Own station channel is 1 to 9: 1 to 960<br>• Own station channel is 10 to 17: 1 to 3960                                                                                                                                                                                                                       |  |     |    |    |    |    |     |  |     |  |    |     |  |     |  |

| Variable name     | Name                           | Data type                           | Range      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------------|--------------------------------|-------------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|-----|--|--|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| i_uWriteData      | Write data storage destination | Word [unsigned]/bit string [16-bit] | —          | <p>Specify the start device number of the device for storing the write data.</p> <p>■When the 0th bit of the subcommand is 0<br/>The device data is written in units of words.<br/>Example: When writing the bit device M100 to M115 (one word) in units of words<br/>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td colspan="4">...</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td></tr></table><div>M115...M100</div></div> <p>Example: When writing the word device D0 to D2 in units of words<br/>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr></table><div>D0</div></div> <p>2nd word:</p> <div><div>b15b8b7b0</div><table><tr><td>0</td><td>0</td><td>0</td><td>2</td></tr></table><div>D1</div></div> <p>3rd word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>D</td><td>E</td><td>F</td></tr></table><div>D2</div></div> <p>■When the 0th bit of the subcommand is 1<br/>The device data is written in units of bits.<br/>Example: When writing the bit device M100 to M107 in units of bits<br/>1st word:</p> <div><div>b15b8b7b0</div><table><tr><td>0</td><td>1</td><td>0</td><td>0</td></tr></table><div>M102M103M100M101</div></div> <p>2nd word:</p> <div><div>b15b8b7b0</div><table><tr><td>1</td><td>1</td><td>0</td><td>0</td></tr></table><div>M106M107M104M105</div></div> | 1 | 2 | 3 | 4 | ... |  |  |  | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 2 | 3 | 4 | 0 | 0 | 0 | 2 | 1 | D | E | F | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1                 | 2                              | 3                                   | 4          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| ...               |                                |                                     |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 0                                   | 1          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 1                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 1                                   | 1          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 1                              | 0                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                 | 2                              | 3                                   | 4          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 0                              | 0                                   | 2          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                 | D                              | E                                   | F          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0                 | 1                              | 0                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                 | 1                              | 0                                   | 0          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| i_uChannel        | Own station channel            | Word [unsigned]/bit string [16-bit] | 1 to 17    | <p>Specify the channel to be used by the own station.</p> <ul style="list-style-type: none"><li>• 1: No serial number is given (3E frame used)</li><li>• 2 to 9: Serial number is given (4E frame used)</li><li>• 10 to 17: Station number extension frame</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| i_uTarget_Port_No | Destination port number        | Word [unsigned]/bit string [16-bit] | 1 to 65534 | <p>Specify the UDP port number of an external device.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |   |   |     |  |  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

\*1 For details on each device code, refer to the following.

📖 SLMP Reference Manual



## ■Output arguments

| Variable name | Name              | Data type                           | Description                                                                          | Default value |
|---------------|-------------------|-------------------------------------|--------------------------------------------------------------------------------------|---------------|
| o_bENO        | Execution status  | Bit                                 | On: The execution command is turned on.<br>Off: The execution command is turned off. | Off           |
| o_bOK         | Normal completion | Bit                                 | The FB has been processed normally when this argument is on.                         | Off           |
| o_bErr        | Error completion  | Bit                                 | The FB has been processed abnormally when this argument is on.                       | Off           |
| o_uErrId      | Error code        | Word [unsigned]/bit string [16-bit] | An error code is stored at error completion.                                         | 0             |

## ■Operation parameters

| Variable name        | Name                      | Data type                           | Range                 | Description                                                                                                                                                                                                                                                                 | Default value |
|----------------------|---------------------------|-------------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| pbi_uRequestModuleIO | Requested module I/O No.  | Word [unsigned]/bit string [16-bit] | 03E0H to 03E3H, 03FFH | Specify the module of the access destination.<br>• 03FFH: Own station, control CPU<br>• 03E0H: Multiple CPU No.1<br>• 03E1H: Multiple CPU No.2<br>• 03E2H: Multiple CPU No.3<br>• 03E3H: Multiple CPU No.4                                                                  | 03FFH         |
| pbi_uResendCountMax  | Maximum number of resends | Word [unsigned]/bit string [16-bit] | 0 to 15               | Specify the number of resends to be performed if the data transfer is not completed within the monitoring time specified by pbi_uMonitorTime (Arrival monitoring time).<br>• 0 to 15                                                                                        | 5             |
| pbi_uMonitorTime     | Arrival monitoring time   | Word [unsigned]/bit string [16-bit] | 0, 1 to 32767         | Specify the monitoring time until completion of processing. If the processing is not completed within the monitoring time, data is resent until the value specified in pbi_uResendCountMax (Maximum number of resends) is reached.<br>• 0: 10s<br>• 1 to 32767: 1 to 32767s | 0             |

## ■Public variables

| Variable name              | Name                                                           | Data type                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Default value |
|----------------------------|----------------------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| pbo_uResendCount           | Number of resends                                              | Word [unsigned]/bit string [16-bit]        | The number of resends performed (result) is stored.                                                                                                                                                                                                                                                                                                                                                                                                                              | 0             |
| pbo_u4ErrTime              | Error occurrence time                                          | Word [unsigned]/bit string [16-bit] (0..3) | Clock data at the time of error occurrence is stored.<br>1st word<br>• Upper 8 bits: Month (01H to 12H)<br>• Lower 8 bits: Lower 2 digits of year (00H to 99H)<br>2nd word<br>• Upper 8 bits: Hour (00H to 23H)<br>• Lower 8 bits: Day (01H to 31H)<br>3rd word<br>• Upper 8 bits: Second (00H to 59H)<br>• Lower 8 bits: Minute (00H to 59H)<br>4th word<br>• Upper 8 bits: Upper 2 digits of year (00H to 99H)<br>• Lower 8 bits: Day of week (00H (Sunday) to 06H (Saturday)) | 0             |
| pbo_uErrIP_Address_3rd_4th | IP address of error detected station (third and fourth octets) | Word [unsigned]/bit string [16-bit] (0..1) | The IP addresses (the third and fourth octets) of the station in which an error was detected are stored.*1<br>Example: When the IP address is 192.168.1.2<br>0102h                                                                                                                                                                                                                                                                                                               | 0             |
| pbo_uErrIP_Address_1st_2nd | IP address of error detected station (first and second octets) | Word [unsigned]/bit string [16-bit] (0..1) | The IP addresses (the first and second octets) of the station in which an error was detected are stored.*1<br>Example: When the IP address is 192.168.1.2<br>C0A8h                                                                                                                                                                                                                                                                                                               | 0             |

\*1 The value is stored only when the dedicated instruction was completed with an error.

The value set to the target station address of the input argument is stored in the error-detected device IP addresses (the third and fourth octets) and the error-detected device IP addresses (the first and second octets).

## Processing details

| Item                  | Description                                                                                                                                                                                                                                                                                                                                                                                                  |                                                |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Available device      | Target module                                                                                                                                                                                                                                                                                                                                                                                                | MELSEC MX controller (port for CC-Link IE TSN) |
|                       | CPU module                                                                                                                                                                                                                                                                                                                                                                                                   | MELSEC MX controller                           |
|                       | Engineering tool                                                                                                                                                                                                                                                                                                                                                                                             | GX Works3                                      |
| Language              | Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                               |                                                |
| Usage of labels       | Label: 1076 points<br>Latched label: 0 points<br>The usage of labels embedded in a program depends on the controller used, the devices specified for arguments, and the option settings of GX Works3. For the option settings of GX Works3, refer to the following.<br><a href="#">GX Works3 Operating Manual</a>                                                                                            |                                                |
| Processing            | <ul style="list-style-type: none"> <li>When i_bEN (execution command) is turned on, this function writes device data of the SLMP-compatible device.</li> <li>Execute this FB while the IP address for an external device is specified.</li> <li>This FB uses Write command (command: 1401) of the SLMP. The message of the SLMP command is a binary code. (<a href="#">SLMP Reference Manual</a>)</li> </ul> |                                                |
| FB compilation method | Macro type                                                                                                                                                                                                                                                                                                                                                                                                   |                                                |
| FB operation          | Pulse type (multiple-scan execution type)                                                                                                                                                                                                                                                                                                                                                                    |                                                |

| Item                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Timing chart of I/O signals | <ul style="list-style-type: none"> <li>For normal completion</li> </ul> <ul style="list-style-type: none"> <li>For error completion (When the dedicated instruction was completed with an error)</li> </ul> <p>(1) Error code<br/> (2) Error occurrence time<br/> (3) Error-detected device IP address</p> <ul style="list-style-type: none"> <li>For error completion (When the dedicated instruction was completed successfully but the end code indicates an error)</li> </ul> <p>(1) Error code</p> |

| Item        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Precautions | <ul style="list-style-type: none"> <li>• This FB does not include error recovery processing. Please create error recovery processing separately according to the system and required operations.</li> <li>• This FB uses the SLMPSEND instruction. The SLMPSEND instruction is successfully completed even if the target device returns an abnormal response. Therefore, in this FB, the instruction is determined to be completed successfully or completed with an error by the end code of the response frame in addition to the completion status of the dedicated instruction. If the instruction is determined as completed with an error by the end code, check that the end code is stored in o_uErrId (error code), and 0 (initial value) is stored in pbo_u4ErrTime (error occurrence time), pbo_uErrIP_Address_3rd_4th (error detection device IP address (3rd and 4th octets)) and pbo_uErrIP_Address_1st_2nd (error detection device IP address (1st and 2nd octets)). For the cause of the error, refer the manual for the SLMP-compatible device being used, and take corrective action. (SLMP Reference Manual)</li> <li>• Turn off i_bEN (execution command) after o_bOK (normal completion) or o_bErr (error completion) is turned on. By turning off i_bEN (execution command), o_bOK (normal completion) or o_bErr (error completion) is turned off and o_uErrId (error code) is cleared to 0.</li> <li>• In this FB, access devices (such as link direct device) that are accessed by the extension specification of the SLMP cannot be written.</li> <li>• In this FB, stations in other network cannot be set as the target station.</li> <li>• When this FB is executed for the port of an external device where the remote password is set, execute this FB after performing the unlock processing of the remote password. When this FB is executed for the port of an external device where the remote password is set, an error will occur.</li> <li>• The target station must support "Write (command: 1401)" of the SLMP command.</li> <li>• This FB is for communications in binary code only. (Communications using ASCII code cannot be performed.)</li> <li>• This FB uses UDP communications. The external device must have the same settings.</li> <li>• This FB uses the label initial value by each program. When the program file using this FB is specified to boot file setting for the boot operation in the controller, specify the initial label value file by each program to the boot file setting as well. If an error code that is not described in Page 2026 Error codes appears, the initial label value files by each program may not be set correctly. In this case, specify the initial label value files by each program to the boot file setting.</li> <li>• When this FB is executed, an operation error may occur in the controller. In this case, check the detailed information of the operation error in event history and correct the input argument of the module FB.</li> </ul> |

## ■Error codes

| Error code  | Description                                                                                                               | Action                                                                                   |
|-------------|---------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 100H        | A value out of the range is set in the number of device points (i_uDevicePoints) of the argument.                         | Set the value within the setting range in the number of device points (i_uDevicePoints). |
| Except 100H | Check the error code of the SLMPSEND instruction and take actions.<br>Page 1184 G(P).SLMPSEND, J(P).SLMPSEND, SP.SLMPSEND |                                                                                          |

Point

The function blocks in this chapter are controller module FBs. Use them from [Module] ⇒ [Module FB] of the Element Selection window of the engineering tool.

49.1 Remote Reset

M+MXF-TSN\_RemoteReset2\_IP

Sends the remote RESET of an SLMP request to the target station specified by an IP address.

| Ladder                                                                                                                                                                                                                                                                                                                                       | FBD/LD                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div><div><div></div></div><div><div>B: i_bENo_bENO: B</div><div>DUT: i_stModuleo_bOK: B</div><div>UW: i_u2TargetAddresso_bErr: B</div><div>UW: i_uTarget_Port_No o_uErrId: UW</div><div>UW: i_uChannel</div></div><div><div>pbo_u4ErrTime 0</div><div>pbo_uErrIP_Address_3rd_4th 0</div><div>pbo_uErrIP_Address_1st_2nd 0</div></div></div> | <div><div><div></div></div><div><div>i_bENo_bENO</div><div>i_stModuleo_bOK</div><div>i_u2TargetAddresso_bErr</div><div>i_uTarget_Port_No o_uErrId</div><div>i_uChannel</div></div></div> |

ST

```
M_MXF_TSN_RemoteReset2_IP(  
  i_bEN:= ?BOOL? ,  
  i_stModule:= ?M+MX_TSN? ,  
  i_u2TargetAddress:= ?WORD(0..1)? ,  
  i_uTarget_Port_No:= ?WORD? ,  
  i_uChannel:= ?WORD? ,  
  o_bENO=> ?BOOL? ,  
  o_bOK=> ?BOOL? ,  
  o_bErr=> ?BOOL? ,  
  o_uErrId=> ?WORD?  
);
```

## Setting data

### Input arguments

| Variable name     | Name                          | Data type                                  | Range                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |     |    |    |    |    |   |  |   |  |    |   |  |   |  |
|-------------------|-------------------------------|--------------------------------------------|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----|----|----|----|----|---|--|---|--|----|---|--|---|--|
| i_bEN             | Execution command             | Bit                                        | —                                                   | On: Start FB.<br>Off: Do not start FB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |     |    |    |    |    |   |  |   |  |    |   |  |   |  |
| i_stModule        | Module label                  | Structure                                  | —                                                   | Specify the module label of the controller executing the FB.<br>(Example: MX_TSN)                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |     |    |    |    |    |   |  |   |  |    |   |  |   |  |
| i_u2TargetAddress | IP address of external device | Word [unsigned]/bit string [16-bit] (0..1) | 0.0.0.1 to 253.255.255.254 (00000001H to DFFFFFFEH) | Specify the IP address of an external device. When specifying the address using a label, use an array as the data type.<br>• 00000001H to DFFFFFFEH<br>Specify a value within the range of 1 to 254 (FEH) for the fourth octet.<br><br><div style="text-align: center;"> <table> <tr> <td></td><td>b15</td><td>b8</td><td>b7</td><td>b0</td></tr> <tr> <td>+0</td><td colspan="2">3</td><td colspan="2">4</td></tr> <tr> <td>+1</td><td colspan="2">1</td><td colspan="2">2</td></tr> </table> </div><br>1 to 4: IP address octet |  | b15 | b8 | b7 | b0 | +0 | 3 |  | 4 |  | +1 | 1 |  | 2 |  |
|                   | b15                           | b8                                         | b7                                                  | b0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |     |    |    |    |    |   |  |   |  |    |   |  |   |  |
| +0                | 3                             |                                            | 4                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |     |    |    |    |    |   |  |   |  |    |   |  |   |  |
| +1                | 1                             |                                            | 2                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |     |    |    |    |    |   |  |   |  |    |   |  |   |  |
| i_uTarget_Port_No | Destination port number       | Word [unsigned]/bit string [16-bit]        | 1 to 65534                                          | Specify the UDP port number of an external device.<br>For the port number to specify, check the manual for the external device.                                                                                                                                                                                                                                                                                                                                                                                                   |  |     |    |    |    |    |   |  |   |  |    |   |  |   |  |
| i_uChannel        | Own station channel           | Word [unsigned]/bit string [16-bit]        | 1 to 17                                             | Specify the channel to be used by the own station.*1                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |     |    |    |    |    |   |  |   |  |    |   |  |   |  |

\*1 To perform communications using the frame without the serial number on this FB, specify 1 to the own station channel. When a number of 2 to 9 is specified, this FB communicates using the frame with the serial number. When a number of 10 to 17 is specified, this FB communicates using the station number extension frame.

### Output arguments

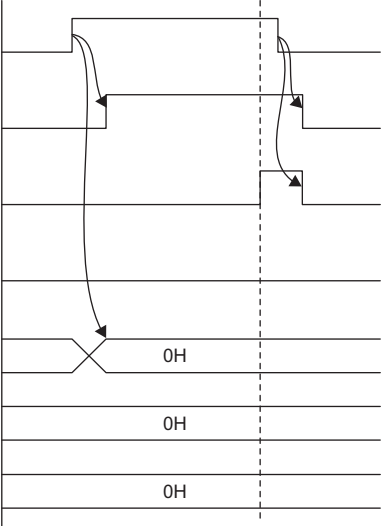
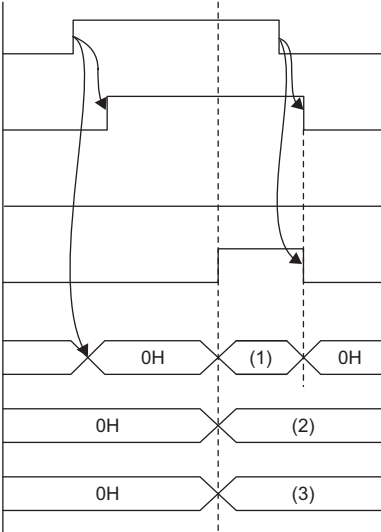
| Variable name | Name              | Data type                           | Description                                                                          | Default value |
|---------------|-------------------|-------------------------------------|--------------------------------------------------------------------------------------|---------------|
| o_bENO        | Execution status  | Bit                                 | On: The execution command is turned on.<br>Off: The execution command is turned off. | Off           |
| o_bOK         | Normal completion | Bit                                 | The FB has been processed normally when this argument is on.                         | Off           |
| o_bErr        | Error completion  | Bit                                 | The FB has been processed abnormally when this argument is on.                       | Off           |
| o_uErrId      | Error code        | Word [unsigned]/bit string [16-bit] | An error code is stored at error completion.                                         | 0             |

## Public variables

| Variable name                | Name                                                             | Data type                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Default value |
|------------------------------|------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| pbo_u4ErrTime                | Error occurrence time                                            | Word [unsigned]/bit string [16-bit] (0..3) | Clock data at the time of error occurrence is stored. <sup>*1</sup><br>1st word<br>• Upper 8 bits: Month (01H to 12H)<br>• Lower 8 bits: Lower 2 digits of year (00H to 99H)<br>2nd word<br>• Upper 8 bits: Hour (00H to 23H)<br>• Lower 8 bits: Day (01H to 31H)<br>3rd word<br>• Upper 8 bits: Second (00H to 59H)<br>• Lower 8 bits: Minute (00H to 59H)<br>4th word<br>• Upper 8 bits: Upper 2 digits of year (00H to 99H)<br>• Lower 8 bits: Day of week (00H (Sunday) to 06H (Saturday)) | 0             |
| pbo_uErrIP_Addresses_3rd_4th | Error-detected device IP addresses (the third and fourth octets) | Word [unsigned]/bit string [16-bit]        | The IP addresses (the third and fourth octets) of the station in which an error was detected are stored. <sup>*1</sup><br>Example: When the IP address is 192.168.1.2<br>0102h                                                                                                                                                                                                                                                                                                                 | 0             |
| pbo_uErrIP_Addresses_1st_2nd | Error-detected device IP addresses (the first and second octets) | Word [unsigned]/bit string [16-bit]        | The IP addresses (the first and second octets) of the station in which an error was detected are stored. <sup>*1</sup><br>Example: When the IP address is 192.168.1.2<br>C0A8h                                                                                                                                                                                                                                                                                                                 | 0             |

<sup>\*1</sup> The value is stored only when the dedicated instruction was completed with an error.  
 The value set to the target station address of the input argument is stored in the error-detected device IP addresses (the third and fourth octets) and the error-detected device IP addresses (the first and second octets).

## Processing details

| Item                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Available device            | Target module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | MELSEC MX controller (port for CC-Link IE TSN) |
|                             | CPU module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | MELSEC MX controller                           |
|                             | Engineering tool                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | GX Works3                                      |
| Language                    | Ladder diagram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                |
| Usage of labels             | Label: 72 points<br>Latched label: 0 points<br>The usage of labels embedded in a program depends on the controller used, the devices specified for arguments, and the option settings of GX Works3. For the option settings of GX Works3, refer to the following.<br><a href="#">GX Works3 Operating Manual</a>                                                                                                                                                                                                                 |                                                |
| Processing                  | When i_bEN (execution command) is turned on, this function sends the remote RESET of an SLMP request to the target station.                                                                                                                                                                                                                                                                                                                                                                                                     |                                                |
| FB compilation method       | Macro type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                |
| FB operation                | Pulse type (multiple-scan execution type)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                |
| Input condition for FB_EN   | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                |
| Timing chart of I/O signals | <div> <ul style="list-style-type: none"> <li>For normal completion</li> </ul>  </div> <div> <ul style="list-style-type: none"> <li>For error completion (When the dedicated instruction was completed with an error)</li> </ul>  <p>(1) Error code<br/>           (2) Error occurrence time<br/>           (3) Error-detected station address</p> </div> |                                                |



| Item        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Precautions | <ul style="list-style-type: none"> <li>• This FB does not include error recovery processing. Please create error recovery processing separately according to the system and required operations.</li> <li>• This FB uses the SLMPSND instruction. Even if the target device has sent an abnormal response, the SLMPSND instruction is completed successfully.</li> <li>• When the SLMPSND instruction is completed successfully, the values are not stored to the error occurrence time of the public variable, pbo_uErrIP_Address_3rd_4th (error-detected device IP addresses (the third and fourth octets)), and pbo_uErrIP_Address_1st_2nd (error-detected device IP addresses (the first and second octets)).<sup>*1</sup></li> <li>• Turn off i_bEN (execution command) after o_bOK (normal completion) or o_bErr (error completion) is turned on. By turning off i_bEN (execution command), o_bOK (normal completion) or o_bErr (error completion) is turned off and o_uErrId (error code) is cleared to 0.</li> <li>• When the remote RESET request is sent and completed successfully, o_bOK (normal completion) is turned on. Whether the target station is actually reset remotely or not depends on the target station status.</li> <li>• In this FB, stations in other network cannot be set as the target station.</li> <li>• The external device must support SLMP command (Remote Reset (1006H)).</li> <li>• This FB uses UDP communications. The external device must have the same settings.</li> </ul> |

\*1 If 0 (initial value) is stored in the error occurrence time, the error-detected device IP addresses (the third and fourth octets), and the error-detected device IP addresses (the first and second octets), check and take actions using the manuals for the SLMP-compatible device used.

## Operation error

The error code occurred by this FB is the same as the SLMPSND instruction.

☞ Page 1184 G(P).SLMPSND, J(P).SLMPSND, SP.SLMPSND

# MEMO

---

# APPENDIX

## Appendix 1 Instruction Processing Time

The following table lists the processing time of each instruction.

The processing time varies depending on the contents of the source and destination, and the processing optimized according to the program. Assume that the values in the table are reference values.

| Instruction classification |                                  |                                                  | Instruction name | Condition      | Processing time [ns] |
|----------------------------|----------------------------------|--------------------------------------------------|------------------|----------------|----------------------|
| Large classification       | Middle classification            | Small classification                             |                  |                | Minimum              |
| Sequence instruction       | Contact instruction              | —                                                | LD               | Bit device     | 1.25                 |
|                            |                                  |                                                  |                  | Bit type label | 1.25                 |
|                            | Output instruction               | —                                                | OUT              | Bit device     | 34.40                |
|                            |                                  |                                                  |                  | Bit type label | 1.04                 |
|                            |                                  |                                                  | OUT T            | —              | 68.42                |
|                            |                                  |                                                  | OUT LT           | —              | 102.46               |
| Basic instruction          | Data transfer instruction        | —                                                | MOV              | —              | 2.71                 |
|                            |                                  |                                                  | BMOV             | n=1            | 533.02               |
|                            |                                  |                                                  |                  | n=1024         | 1227.24              |
|                            |                                  |                                                  | FMOV             | n=1            | 324.21               |
|                            |                                  |                                                  |                  | n=1024         | 1035.68              |
|                            | Arithmetic operation instruction | Increment                                        | INC              | —              | 5.27                 |
|                            |                                  | Four arithmetic operations instruction (integer) | +                | —              | 1.36                 |
|                            |                                  |                                                  | -                | —              | 1.36                 |
|                            |                                  |                                                  | *                | —              | 1.36                 |
|                            |                                  |                                                  | /                | —              | 1.36                 |

| Instruction classification |                                         |                                                                       | Instruction name | Condition                                                                               | Processing time [ns] |
|----------------------------|-----------------------------------------|-----------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------------------|----------------------|
| Large classification       | Middle classification                   | Small classification                                                  |                  |                                                                                         | Minimum              |
| Application instruction    | Floating-point instruction              | Four arithmetic operations instruction (single-precision real number) | E+               | $s1 = 2^{126}, s2 = 2^{127}$                                                            | 118.2                |
|                            |                                         |                                                                       | E-               | $s1 = 2^{126}, s2 = 2^{127}$                                                            | 118.43               |
|                            |                                         |                                                                       | E*               | $s1 = 2^{63}, s2 = 2^{64}$                                                              | 116.89               |
|                            |                                         |                                                                       | E/               | $s1 = 2^{126}, s2 = 2^{127}$                                                            | 155.7                |
|                            |                                         | Four arithmetic operations instruction (double-precision real number) | ED+              | $s1 = 2^{1022}, s2 = 2^{1023}$                                                          | 110.53               |
|                            |                                         |                                                                       | ED-              | $s1 = 2^{1022}, s2 = 2^{1023}$                                                          | 110.71               |
|                            |                                         |                                                                       | ED*              | $s1 = 2^{511}, s2 = 2^{512}$                                                            | 109.45               |
|                            |                                         |                                                                       | ED/              | $s1 = 2^{1022}, s2 = 2^{1023}$                                                          | 124.91               |
|                            |                                         | Trigonometric function (single-precision real number)                 | SIN              | $s = E0.7853982$ (45 degrees)                                                           | 308.08               |
|                            |                                         | Trigonometric function (double-precision real number)                 | SIND             | $s = E0.7853982$ (45 degrees)                                                           | 234.33               |
|                            |                                         | Real number data transfer (single-precision real number)              | EMOV             | $s = \text{Internal device}, d = \text{Internal device}$                                | 2.73                 |
|                            |                                         |                                                                       |                  | $s = E1.23, d = \text{Internal device}$                                                 | 1.36                 |
|                            |                                         | Real number data transfer (double-precision real number)              | EDMOV            | $s = \text{Internal device}, d = \text{Internal device}$                                | 2.73                 |
|                            |                                         |                                                                       |                  | $s = E1.23, d = \text{Internal device}$                                                 | 2.5                  |
|                            | PID control instruction                 | Inexact differential                                                  | S.PIDINIT        | One loop                                                                                | 3845.1               |
|                            |                                         |                                                                       |                  | 32 loops                                                                                | 7456.2               |
|                            |                                         |                                                                       | S.PIDCONT        | One loop                                                                                | 677.4                |
|                            |                                         |                                                                       |                  | 32 loops                                                                                | 11362.6              |
|                            | Structure creation instruction          | Iteration instruction                                                 | FOR              | —                                                                                       | 2.72                 |
|                            |                                         |                                                                       | NEXT             | —                                                                                       | 1.06                 |
|                            |                                         | Subroutine call instruction                                           | CALL             | Local pointer                                                                           | 1514.5               |
|                            |                                         |                                                                       |                  | Global pointer                                                                          | 2175.8               |
|                            |                                         |                                                                       | RET              | Returning to the own program                                                            | 736.7                |
|                            |                                         |                                                                       |                  | Returning to another program                                                            | 1058.3               |
|                            | Module access instruction               | —                                                                     | TO               | $n=1$                                                                                   | 10866                |
|                            |                                         |                                                                       |                  | $n=1024$                                                                                | 715892               |
|                            |                                         |                                                                       | FROM             | $n=1$                                                                                   | 11697                |
|                            |                                         |                                                                       |                  | $n=1024$                                                                                | 694319               |
| Dedicated instruction      | Built-in Ethernet instruction           | Sending an SLMP message                                               | GP.SLMPSND       | Read (command: 0401H) (reading in units of words):<br>Number of read points = One point | 2687                 |
|                            | Intelligent function module instruction | Reading data from the programmable controller on another station      | GP.READ          | —                                                                                       | 121173               |
| FB/FUN call                | FB call                                 | FB call                                                               | —                | Local FB                                                                                | 2793                 |
|                            |                                         |                                                                       |                  | Global FB                                                                               | 3042                 |
|                            | FUN call                                | FUN call                                                              | —                | —                                                                                       | 2073                 |
|                            | Inline ST call                          | Inline ST call                                                        | —                | —                                                                                       | 856.77               |
| ST control statement       | Conditional branch                      | —                                                                     | IF               | —                                                                                       | 2.61                 |
|                            | Iteration                               | —                                                                     | CASE             | —                                                                                       | 3.07                 |
|                            |                                         |                                                                       | ST_FOR           | —                                                                                       | 11.26                |



# INDEX

## Symbols

|    |    |
|----|----|
| -  | 94 |
| *  | 94 |
| ** | 94 |
| /  | 94 |
| &  | 94 |
| +  | 94 |
| <  | 94 |
| <= | 94 |
| <> | 94 |
| =  | 94 |
| >  | 94 |
| >= | 94 |

## 0 to 9

|                                |    |
|--------------------------------|----|
| 16-bit data (word data)        | 34 |
| 32-bit data (double word data) | 36 |

## A

|                      |         |
|----------------------|---------|
| AND                  | 94      |
| ASCII                | 106,118 |
| Assignment statement | 96      |

## B

|                                        |      |
|----------------------------------------|------|
| Basic instruction                      | 258  |
| Bit data                               | 33   |
| Buffer memory                          | 22   |
| Built-in Ethernet function instruction | 1146 |

## C

|                                              |        |
|----------------------------------------------|--------|
| CASE                                         | 99     |
| Communication execution status output device | 1218   |
| Conversion of data type                      | 97,111 |

## D

|                                   |    |
|-----------------------------------|----|
| Data link                         | 25 |
| Destination (d)                   | 28 |
| Device station                    | 22 |
| Device supporting iQSS            | 25 |
| Double-precision real number data | 40 |

## E

|                     |       |
|---------------------|-------|
| EN                  | 63,75 |
| ENO                 | 63,75 |
| Execution condition | 44    |
| EXIT                | 100   |
| External variable   | 68    |

## F

|                |        |
|----------------|--------|
| FB file        | 67,76  |
| FOR...DO       | 99,104 |
| FUN file       | 62,64  |
| Function (FUN) | 60,62  |

|                                        |       |
|----------------------------------------|-------|
| Function block (FB)                    | 60,66 |
| Function block call statement          | 98    |
| Function call statement                | 98    |
| Function codes and function parameters | 1216  |

## I

|                           |       |
|---------------------------|-------|
| IF THEN                   | 99    |
| IF...ELSE                 | 99    |
| IF...ELSIF                | 99    |
| Input variable            | 63,67 |
| Input/output variable     | 67    |
| Instance                  | 69    |
| Instruction configuration | 28    |
| Internal variable         | 68    |
| Interrupt program         | 61    |

## L

|                |    |
|----------------|----|
| Ladder diagram | 86 |
| Link device    | 23 |

## M

|                               |      |
|-------------------------------|------|
| Main routine program          | 61   |
| Master station                | 23   |
| MOD                           | 94   |
| MOTION CONTROL FUNCTION BLOCK | 1427 |

## N

|                         |      |
|-------------------------|------|
| NETWORK FUNCTION BLOCKS | 1985 |
| NOT                     | 94   |
| Note                    | 91   |
| Numerical value (n)     | 29   |

## O

|                 |       |
|-----------------|-------|
| OR              | 94    |
| Output variable | 63,67 |

## P

|                         |       |
|-------------------------|-------|
| PID control instruction | 1045  |
| Program                 | 64,76 |
| Program Block           | 61    |

## R

|                                        |    |
|----------------------------------------|----|
| Real number data (floating-point data) | 39 |
| REPEAT...UNTIL                         | 99 |
| Reserved word                          | 93 |
| RETURN                                 | 98 |

## S

|                                   |         |
|-----------------------------------|---------|
| Sequence instruction              | 206     |
| Shift JIS                         | 106,118 |
| Single-precision real number data | 39      |
| Source (s)                        | 28      |
| STANDARD FUNCTION BLOCKS          | 1397    |

|                                      |         |
|--------------------------------------|---------|
| STANDARD FUNCTIONS .....             | 1221    |
| Statement .....                      | 91      |
| Station sub ID number .....          | 25      |
| STRING .....                         | 106,118 |
| String .....                         | 106,118 |
| String [Unicode] .....               | 106,118 |
| String data .....                    | 42      |
| Subroutine program .....             | 61      |
| Subroutine type function block ..... | 67      |

## T

---

|                                 |         |
|---------------------------------|---------|
| Type specifier .....            | 107,118 |
| Types of PID instructions ..... | 1029    |

## U

---

|               |     |
|---------------|-----|
| Unicode ..... | 106 |
|---------------|-----|

## W

---

|                  |         |
|------------------|---------|
| WHILE...DO ..... | 99      |
| WSTRING .....    | 106,118 |

## X

---

|           |    |
|-----------|----|
| XOR ..... | 94 |
|-----------|----|

# INSTRUCTION INDEX

## Symbols

|                  |         |
|------------------|---------|
| -(P)( <u>U</u> ) | 272,274 |
| *(P)( <u>U</u> ) | 284     |
| /(P)( <u>U</u> ) | 286     |
| +(P)( <u>U</u> ) | 268,270 |
| \$+(P)           | 725,727 |
| \$MOV(P)         | 729     |
| \$MOV(P)_WS      | 731     |

## A

|                      |      |
|----------------------|------|
| ABS( <u>E</u> )      | 1316 |
| ACOS( <u>E</u> )     | 1327 |
| ACOS(P)              | 874  |
| ACOSD(P)             | 886  |
| ADD( <u>E</u> )      | 1329 |
| ADD_TIME( <u>E</u> ) | 1389 |
| ADPRW                | 1215 |
| ADRSET(P)            | 961  |
| ANB                  | 214  |
| AND                  | 206  |
| AND( <u>E</u> )      | 1354 |
| AND<( <u>U</u> )     | 258  |
| AND<=( <u>U</u> )    | 258  |
| AND<>( <u>U</u> )    | 258  |
| AND=( <u>U</u> )     | 258  |
| AND>( <u>U</u> )     | 258  |
| AND>=( <u>U</u> )    | 258  |
| AND\$<               | 722  |
| AND\$<=              | 722  |
| AND\$<>              | 722  |
| AND\$=               | 722  |
| AND\$>               | 722  |
| AND\$>=              | 722  |
| ANDD<( <u>U</u> )    | 260  |
| ANDD<=( <u>U</u> )   | 260  |
| ANDD<>( <u>U</u> )   | 260  |
| ANDD=( <u>U</u> )    | 260  |
| ANDD>( <u>U</u> )    | 260  |
| ANDD>=( <u>U</u> )   | 260  |
| ANDD_EQ( <u>U</u> )  | 260  |
| ANDD_GE( <u>U</u> )  | 260  |
| ANDD_GT( <u>U</u> )  | 260  |
| ANDD_LE( <u>U</u> )  | 260  |
| ANDD_LT( <u>U</u> )  | 260  |
| ANDD_NE( <u>U</u> )  | 260  |
| ANDDT=               | 988  |
| ANDDT>               | 988  |
| ANDDT>=              | 988  |
| ANDDT_EQ             | 988  |
| ANDDT_GE             | 988  |
| ANDDT_GT             | 988  |
| ANDDT_LE             | 988  |
| ANDDT_LT             | 988  |
| ANDDT_NE             | 988  |
| ANDE=                | 812  |
| ANDE>                | 812  |
| ANDE>=               | 812  |
| ANDED=               | 814  |
| ANDED>               | 814  |
| ANDED>=              | 814  |

|                    |      |
|--------------------|------|
| ANDED_EQ           | 814  |
| ANDED_GE           | 814  |
| ANDED_GT           | 814  |
| ANDED_LE           | 814  |
| ANDED_LT           | 814  |
| ANDED_NE           | 814  |
| ANDE_EQ            | 812  |
| ANDE_GE            | 812  |
| ANDE_GT            | 812  |
| ANDE_LE            | 812  |
| ANDE_LT            | 812  |
| ANDE_NE            | 812  |
| AND_EQ( <u>U</u> ) | 258  |
| ANDF               | 208  |
| ANDFI              | 211  |
| AND_GE( <u>U</u> ) | 258  |
| AND_GT( <u>U</u> ) | 258  |
| AND_LE( <u>U</u> ) | 258  |
| AND_LT( <u>U</u> ) | 258  |
| AND_NE( <u>U</u> ) | 258  |
| ANDP               | 208  |
| ANDPI              | 211  |
| ANDSTRING_EQ       | 722  |
| ANDSTRING_GE       | 722  |
| ANDSTRING_GT       | 722  |
| ANDSTRING_LE       | 722  |
| ANDSTRING_LT       | 722  |
| ANDSTRING_NE       | 722  |
| ANDTM=             | 992  |
| ANDTM>             | 992  |
| ANDTM>=            | 992  |
| ANDTM_EQ           | 992  |
| ANDTM_GE           | 992  |
| ANDTM_GT           | 992  |
| ANDTM_LE           | 992  |
| ANDTM_LT           | 992  |
| ANDTM_NE           | 992  |
| ANI                | 206  |
| ASC2INT(P)         | 477  |
| ASIN( <u>E</u> )   | 1326 |
| ASIN(P)            | 872  |
| ASIND(P)           | 884  |
| ATAN( <u>E</u> )   | 1328 |
| ATAN(P)            | 876  |
| ATAND(P)           | 888  |

## B

|                           |         |
|---------------------------|---------|
| B-(P)                     | 295,296 |
| B*(P)                     | 305     |
| B/(P)                     | 307     |
| B+(P)                     | 292,293 |
| BACOS(P)                  | 898     |
| BAND(P)( <u>U</u> )       | 668     |
| BASIN(P)                  | 896     |
| BATAN(P)                  | 900     |
| BCD(P)                    | 392     |
| BCDDA(P)                  | 756     |
| BCD_TO_DINT( <u>E</u> )   | 1267    |
| BCD_TO_INT( <u>E</u> )    | 1265    |
| BCD_TO_STRING( <u>E</u> ) | 1270    |
| BCOS(P)                   | 892     |



|                          |         |
|--------------------------|---------|
| DEC(P)(_U) .....         | 324     |
| DECO(P) .....            | 483     |
| DEG(P) .....             | 904     |
| DEGD(P) .....            | 908     |
| DELETE(_E) .....         | 1382    |
| DELTA(P) .....           | 245     |
| DFMOV(P) .....           | 520     |
| DFMOVL(P) .....          | 522     |
| DFROM(P) .....           | 1009    |
| DFROMD(P) .....          | 1017    |
| DGBIN(P)(_U) .....       | 446     |
| DGRY(P)(_U) .....        | 442     |
| DHABIN(P) .....          | 462     |
| DHCMOV(P) .....          | 1122    |
| DHIOEN(P) .....          | 1080    |
| DI .....                 | 538,542 |
| DI_1 .....               | 542     |
| DINC(P)(_U) .....        | 325     |
| DINT2DBL(P) .....        | 851     |
| DINT2FLT(P) .....        | 843     |
| DINT2INT(P) .....        | 428     |
| DINT2UDINT(P) .....      | 432     |
| DINT2UINT(P) .....       | 430     |
| DINT_TO_BCD(_E) .....    | 1258    |
| DINT_TO_BITARR(_E) ..... | 1307    |
| DINT_TO_BOOL(_E) .....   | 1253    |
| DINT_TO_DWORD(_E) .....  | 1256    |
| DINT_TO_INT(_E) .....    | 1257    |
| DINT_TO_LREAL(_E) .....  | 1261    |
| DINT_TO_REAL(_E) .....   | 1260    |
| DINT_TO_STRING(_E) ..... | 1263    |
| DINT_TO_TIME(_E) .....   | 1262    |
| DINT_TO_WORD(_E) .....   | 1254    |
| DIS(P) .....             | 490     |
| DITRG .....              | 1113    |
| DIV(_E) .....            | 1338    |
| DIVISION(P)(_U) .....    | 286     |
| DIV_TIME(_E) .....       | 1395    |
| DLIMIT(P)(_U) .....      | 666     |
| DMAX(P)(_U) .....        | 698     |
| DMEAN(P)(_U) .....       | 714     |
| DMIN(P)(_U) .....        | 702     |
| DMINUS(P)(_U) .....      | 282     |
| DMOV(P) .....            | 504     |
| DMULTI(P)(_U) .....      | 288     |
| DNEG(P) .....            | 482     |
| DOR(P) .....             | 339,341 |
| DPLSV .....              | 1096    |
| DPLUS(P)(_U) .....       | 278     |
| DPWMH .....              | 1131    |
| DRCL(P) .....            | 596     |
| DRCR(P) .....            | 594     |
| DROL(P) .....            | 596     |
| DROR(P) .....            | 594     |
| DRVA .....               | 1106    |
| DRVI .....               | 1101    |
| DRVTL .....              | 1111    |
| DSCL(P)(_U) .....        | 679     |
| DSCL2(P)(_U) .....       | 684     |
| DSERDATA(P) .....        | 688     |
| DSERMM(P) .....          | 692     |
| DSFL(P) .....            | 382     |
| DSFR(P) .....            | 380     |
| DSORTD(_U) .....         | 706     |
| DSPDH .....              | 1141    |
| DSQRT(P) .....           | 717     |

|                           |         |
|---------------------------|---------|
| DSTR(P)(_U) .....         | 753     |
| DSUM(P) .....             | 695     |
| DSWAP(P) .....            | 529     |
| DSZR .....                | 1083    |
| DTEST(P) .....            | 368     |
| DTO(P) .....              | 1012    |
| DTOD(P) .....             | 1021    |
| DUTY .....                | 1003    |
| DVAL(P)(_U) .....         | 474     |
| DVIT .....                | 1090    |
| DWORD_TO_BOOL(_E) .....   | 1234    |
| DWORD_TO_DINT(_E) .....   | 1239    |
| DWORD_TO_INT(_E) .....    | 1237    |
| DWORD_TO_STRING(_E) ..... | 1241    |
| DWORD_TO_TIME(_E) .....   | 1240    |
| DWORD_TO_WORD(_E) .....   | 1235    |
| DWSUM(P)(_U) .....        | 710     |
| DXCH(P) .....             | 525     |
| DXNR(P) .....             | 357,359 |
| DXOR(P) .....             | 348,350 |
| DZONE(P)(_U) .....        | 674     |

## E

|                     |         |
|---------------------|---------|
| E-(P) .....         | 821,823 |
| E*(P) .....         | 833     |
| E/(P) .....         | 835     |
| E+(P) .....         | 817,819 |
| ECALL(P) .....      | 571     |
| ED-(P) .....        | 829,831 |
| ED*(P) .....        | 837     |
| ED/(P) .....        | 839     |
| ED+(P) .....        | 825,827 |
| EDDIVISION(P) ..... | 839     |
| EDIVISION(P) .....  | 835     |
| EDMAX(P) .....      | 936     |
| EDMIN(P) .....      | 940     |
| EDMINUS(P) .....    | 831     |
| EDMOV(P) .....      | 865     |
| EDMULTI(P) .....    | 837     |
| EDNEG(P) .....      | 863     |
| EDPLUS(P) .....     | 827     |
| EDSQRT(P) .....     | 912     |
| EFCALL(P) .....     | 578     |
| EGF .....           | 217     |
| EGP .....           | 217     |
| EI .....            | 538     |
| EMAX(P) .....       | 934     |
| EMIN(P) .....       | 938     |
| EMINUS(P) .....     | 823     |
| EMOD(P) .....       | 479     |
| EMOV(P) .....       | 864     |
| EMULTI(P) .....     | 833     |
| ENCO(P) .....       | 485     |
| END .....           | 254     |
| ENEG(P) .....       | 862     |
| EPLUS(P) .....      | 819     |
| EQ(_E) .....        | 1367    |
| EREXP(P) .....      | 860     |
| ESQRT(P) .....      | 910     |
| ESTR(P) .....       | 765     |
| EVAL(P) .....       | 855     |
| EXP(_E) .....       | 1322    |
| EXP(P) .....        | 914     |
| EXPD(P) .....       | 916     |
| EXPT(_E) .....      | 1342    |

**F**

|                   |      |
|-------------------|------|
| FCALL(P).....     | 565  |
| FDEL(P).....      | 606  |
| FEND.....         | 253  |
| FF.....           | 244  |
| FIFR(P).....      | 598  |
| FIFW(P).....      | 602  |
| FIND(_E).....     | 1387 |
| FINS(P).....      | 604  |
| FLT2DBL(P).....   | 853  |
| FLT2DINT(P).....  | 404  |
| FLT2INT(P).....   | 400  |
| FLT2UDINT(P)..... | 406  |
| FLT2UINT(P).....  | 402  |
| FMOV(P).....      | 516  |
| FMOVL(P).....     | 518  |
| FOR.....          | 553  |
| FPOP(P).....      | 600  |
| FROM(P).....      | 1009 |
| FROMD(P).....     | 1017 |
| F_TRIG(_E).....   | 1404 |

**G**

|                         |      |
|-------------------------|------|
| G.SOCRCVS.....          | 1157 |
| G(P).SLMPSND.....       | 1184 |
| G(P).SLMPSNDC.....      | 1194 |
| G(P).SOCRDATA.....      | 1174 |
| G(P)_SLMPSND.....       | 1184 |
| G(P)_SLMPSNDC.....      | 1194 |
| G(P)_SOCRDATA.....      | 1174 |
| GBIN(P)(_U).....        | 444  |
| GE(_E).....             | 1367 |
| GET_BIT_OF_INT(_E)..... | 1309 |
| GET_BOOL_ADDR.....      | 1315 |
| GET_INT_ADDR.....       | 1315 |
| GET_WORD_ADDR.....      | 1315 |
| GOEND.....              | 537  |
| GP.ECPRTCL.....         | 1176 |
| GP.FTPCGET.....         | 1209 |
| GP.FTPCPUT.....         | 1203 |
| GP.SOCCINF.....         | 1164 |
| GP.SOCCLOSE.....        | 1150 |
| GP.SOCCSET.....         | 1167 |
| GP.SOCOPEN.....         | 1146 |
| GP.SOCRCV.....          | 1152 |
| GP.SOCRMODE.....        | 1169 |
| GP.SOCSND.....          | 1160 |
| GP_ECPRTCL.....         | 1176 |
| GP_FTPCGET.....         | 1209 |
| GP_FTPCPUT.....         | 1203 |
| GP_SOCCINF.....         | 1164 |
| GP_SOCCLOSE.....        | 1150 |
| GP_SOCCSET.....         | 1167 |
| GP_SOCOPEN.....         | 1146 |
| GP_SOCRCV.....          | 1152 |
| GP_SOCRMODE.....        | 1169 |
| GP_SOCSND.....          | 1160 |
| GRY(P)(_U).....         | 440  |
| G_SOCRCVS.....          | 1157 |
| GT(_E).....             | 1367 |

**H**

|               |      |
|---------------|------|
| HABIN(P)..... | 459  |
| HCMOV(P)..... | 1119 |

|               |      |
|---------------|------|
| HIOEN(P)..... | 1077 |
|---------------|------|

**I**

|                        |      |
|------------------------|------|
| IMASK.....             | 547  |
| INC(P)(_U).....        | 323  |
| INSERT(_E).....        | 1380 |
| INSTR(P).....          | 806  |
| INT2ASC(P).....        | 770  |
| INT2DBL(P).....        | 849  |
| INT2DINT(P).....       | 418  |
| INT2FLT(P).....        | 841  |
| INT2UDINT(P).....      | 420  |
| INT2UINT(P).....       | 416  |
| INT_TO_BCD(_E).....    | 1246 |
| INT_TO_BITARR(_E)..... | 1306 |
| INT_TO_BOOL(_E).....   | 1242 |
| INT_TO_DINT(_E).....   | 1245 |
| INT_TO_DWORD(_E).....  | 1244 |
| INT_TO_LREAL(_E).....  | 1249 |
| INT_TO_REAL(_E).....   | 1248 |
| INT_TO_STRING(_E)..... | 1251 |
| INT_TO_TIME(_E).....   | 1250 |
| INT_TO_WORD(_E).....   | 1243 |
| INV.....               | 215  |
| IRET.....              | 551  |

**J**

|                   |      |
|-------------------|------|
| J(P).SLMPSND..... | 1184 |
| J(P)_SLMPSND..... | 1184 |
| JMP.....          | 534  |

**L**

|                 |     |
|-----------------|-----|
| LD.....         | 206 |
| LD<(_U).....    | 258 |
| LD<=(_U).....   | 258 |
| LD<>(_U).....   | 258 |
| LD=(_U).....    | 258 |
| LD>(_U).....    | 258 |
| LD>=(_U).....   | 258 |
| LD\$<.....      | 722 |
| LD\$<=.....     | 722 |
| LD\$<>.....     | 722 |
| LD\$=.....      | 722 |
| LD\$>.....      | 722 |
| LD\$>=.....     | 722 |
| LDD<(_U).....   | 260 |
| LDD<=(_U).....  | 260 |
| LDD<>(_U).....  | 260 |
| LDD=(_U).....   | 260 |
| LDD>(_U).....   | 260 |
| LDD>=(_U).....  | 260 |
| LDD_EQ(_U)..... | 260 |
| LDD_GE(_U)..... | 260 |
| LDD_GT(_U)..... | 260 |
| LDD_LE(_U)..... | 260 |
| LDD_LT(_U)..... | 260 |
| LDD_NE(_U)..... | 260 |
| LDDT=.....      | 988 |
| LDDT>.....      | 988 |
| LDDT>=.....     | 988 |
| LDDT_EQ.....    | 988 |
| LDDT_GE.....    | 988 |
| LDDT_GT.....    | 988 |

|                   |                 |
|-------------------|-----------------|
| LDDT_LE           | 988             |
| LDDT_LT           | 988             |
| LDDT_NE           | 988             |
| LDE<              | 812,814,988,992 |
| LDE<=             | 812,814,988,992 |
| LDE<>             | 812,814,988,992 |
| LDE=              | 812             |
| LDE>              | 812             |
| LDE>=             | 812             |
| LDED=             | 814             |
| LDED>             | 814             |
| LDED>=            | 814             |
| LDED_EQ           | 814             |
| LDED_GE           | 814             |
| LDED_GT           | 814             |
| LDED_LE           | 814             |
| LDED_LT           | 814             |
| LDED_NE           | 814             |
| LDE_EQ            | 812             |
| LDE_GE            | 812             |
| LDE_GT            | 812             |
| LDE_LE            | 812             |
| LDE_LT            | 812             |
| LDE_NE            | 812             |
| LD_EQ(_U)         | 258             |
| LDF               | 208             |
| LDFI              | 211             |
| LD_GE(_U)         | 258             |
| LD_GT(_U)         | 258             |
| LDI               | 206             |
| LD_LE(_U)         | 258             |
| LD_LT(_U)         | 258             |
| LD_NE(_U)         | 258             |
| LDP               | 208             |
| LDPI              | 211             |
| LDSTRING_EQ       | 722             |
| LDSTRING_GE       | 722             |
| LDSTRING_GT       | 722             |
| LDSTRING_LE       | 722             |
| LDSTRING_LT       | 722             |
| LDSTRING_NE       | 722             |
| LDTM=             | 992             |
| LDTM>             | 992             |
| LDTM>=            | 992             |
| LDTM_EQ           | 992             |
| LDTM_GE           | 992             |
| LDTM_GT           | 992             |
| LDTM_LE           | 992             |
| LDTM_LT           | 992             |
| LDTM_NE           | 992             |
| LE(_E)            | 1367            |
| LEDR              | 720             |
| LEFT(_E)          | 1373            |
| LEFT(P)           | 799             |
| LEN(_E)           | 1371            |
| LEN(P)            | 795             |
| LIMIT(_E)         | 1362            |
| LIMIT(P)(_U)      | 664             |
| LN(_E)            | 1319            |
| LOG(_E)           | 1320            |
| LOG(P)            | 918             |
| LOG10(P)          | 930             |
| LOG10D(P)         | 932             |
| LOGD(P)           | 920             |
| LREAL_TO_DINT(_E) | 1282            |
| LREAL_TO_INT(_E)  | 1281            |

|                   |      |
|-------------------|------|
| LREAL_TO_REAL(_E) | 1283 |
| LT(_E)            | 1367 |

## M

|                                     |      |
|-------------------------------------|------|
| M+MXF-SQ_ConnectionClose            | 1990 |
| M+MXF-SQ_ConnectionOpen             | 1986 |
| M+MXF-SQ_Recv_Socket                | 1992 |
| M+MXF-SQ_Send_Socket                | 1996 |
| M+MXF-SQ_SLMP_DeviceRead_IP         | 1999 |
| M+MXF-SQ_SLMP_DeviceWrite_IP        | 2006 |
| M+MXF-TSN_RemoteReset2_IP           | 2027 |
| M+MXF-TSN_SLMP_DeviceRead_IP        | 2013 |
| M+MXF-TSN_SLMP_DeviceWrite_IP       | 2020 |
| MAX(_E)                             | 1360 |
| MAX(P)(_U)                          | 696  |
| MC                                  | 249  |
| MC_AbortTrigger                     | 1596 |
| MC_CamIn                            | 1795 |
| MC_CamTableSelect                   | 1602 |
| MC_CombineAxes                      | 1835 |
| MC_DigitalCamSwitch                 | 1640 |
| MC_GearIn                           | 1825 |
| MC_GroupDisable                     | 1532 |
| MC_GroupEnable                      | 1528 |
| MC_GroupReset                       | 1577 |
| MC_GroupSetOverride                 | 1622 |
| MC_GroupStop                        | 1663 |
| MC_Home                             | 1647 |
| MC_MoveAbsolute                     | 1669 |
| MC_MoveRelative                     | 1682 |
| MC_MoveVelocity                     | 1702 |
| MC_Power                            | 1536 |
| MCR                                 | 249  |
| MC_ReadParameter                    | 1561 |
| MC_Reset                            | 1574 |
| MC_SetOverride                      | 1556 |
| MC_SetPosition                      | 1540 |
| MC_Stop                             | 1658 |
| MC_TorqueControl                    | 1710 |
| MC_TouchProbe                       | 1581 |
| MCv_AdvancedSync                    | 1903 |
| MCv_AdvCamSetPositionCalc           | 1637 |
| MCv_AdvPositionPerCycleCalc         | 1634 |
| MCv_AllPower                        | 1619 |
| MCv_BacklashCompensationFilter      | 1847 |
| MCv_ChangeCycle                     | 1611 |
| MCv_CyclicPosition                  | 1932 |
| MCv_CyclicTorque                    | 1946 |
| MCv_CyclicVelocity                  | 1941 |
| MCv_DirectionFilter                 | 1871 |
| MCv_GroupMoveWait                   | 1896 |
| MCv_Jog,MCv                         | 1692 |
| MCv_MotionErrorReset                | 1627 |
| MCv_MoveCircularInterpolateAbsolute | 1759 |
| MCv_MoveCircularInterpolateRelative | 1776 |
| MCv_MoveLinearInterpolateAbsolute   | 1730 |
| MCv_MoveLinearInterpolateRelative   | 1745 |
| MCv_MovePositioningData             | 1909 |
| MCv_MoveWait                        | 1889 |
| MCv_PositionControl                 | 1919 |
| MCv_ReadProfileData                 | 1953 |
| MCv_SetTorqueLimit                  | 1548 |
| MCv_SmoothingFilter                 | 1861 |
| MCv_SpeedControl                    | 1721 |
| MCv_SpeedLimitFilter                | 1880 |

|                         |      |
|-------------------------|------|
| MCv_SyncOperationCycles | 1631 |
| MCv_WriteProfileData    | 1969 |
| MC_WriteParameter       | 1568 |
| MEAN(P)(_U)             | 712  |
| MEF                     | 216  |
| MEP                     | 216  |
| MID(_E)                 | 1376 |
| MIDR(P)                 | 801  |
| MIDW(P)                 | 803  |
| MIN(_E)                 | 1360 |
| MIN(P)(_U)              | 700  |
| MINUS(P)(_U)            | 274  |
| MOD(_E)                 | 1340 |
| MOV(P)                  | 502  |
| MOVB(P)                 | 530  |
| MOVE(_E)                | 1344 |
| MUL(_E)                 | 1332 |
| MULTI(P)(_U)            | 284  |
| MUL_TIME(_E)            | 1393 |
| MUX(_E)                 | 1365 |

## N

|         |      |
|---------|------|
| NDIS(P) | 494  |
| NE(_E)  | 1369 |
| NEG(P)  | 481  |
| NEXT    | 553  |
| NOPLF   | 257  |
| NOT(_E) | 1357 |
| NUNI(P) | 496  |

## O

|            |      |
|------------|------|
| OR         | 206  |
| OR(_E)     | 1354 |
| OR<(_U)    | 258  |
| OR<=( _U)  | 258  |
| OR<>(_U)   | 258  |
| OR=( _U)   | 258  |
| OR>(_U)    | 258  |
| OR>=( _U)  | 258  |
| OR\$<.     | 722  |
| OR\$<=.    | 722  |
| OR\$<>.    | 722  |
| OR\$=.     | 722  |
| OR\$>.     | 722  |
| OR\$>=.    | 722  |
| ORB        | 214  |
| ORD<(_U)   | 260  |
| ORD<=( _U) | 260  |
| ORD<>(_U)  | 260  |
| ORD=( _U)  | 260  |
| ORD>(_U)   | 260  |
| ORD>=( _U) | 260  |
| ORD_EQ(_U) | 260  |
| ORD_GE(_U) | 260  |
| ORD_GT(_U) | 260  |
| ORD_LE(_U) | 260  |
| ORD_LT(_U) | 260  |
| ORD_NE(_U) | 260  |
| ORDT=      | 988  |
| ORDT>      | 988  |
| ORDT>=     | 988  |
| ORDT_EQ    | 988  |
| ORDT_GE    | 988  |
| ORDT_GT    | 988  |

|             |     |
|-------------|-----|
| ORDT_LE     | 988 |
| ORDT_LT     | 988 |
| ORDT_NE     | 988 |
| ORE=        | 812 |
| ORE>        | 812 |
| ORE>=       | 812 |
| ORED=       | 814 |
| ORED>       | 814 |
| ORED>=      | 814 |
| ORED_EQ     | 814 |
| ORED_GE     | 814 |
| ORED_GT     | 814 |
| ORED_LE     | 814 |
| ORED_LT     | 814 |
| ORED_NE     | 814 |
| ORE_EQ      | 812 |
| ORE_GE      | 812 |
| ORE_GT      | 812 |
| ORE_LE      | 812 |
| ORE_LT      | 812 |
| ORE_NE      | 812 |
| OR_EQ(_U)   | 258 |
| ORF         | 208 |
| ORFI        | 211 |
| OR_GE(_U)   | 258 |
| OR_GT(_U)   | 258 |
| ORI         | 206 |
| OR_LE(_U)   | 258 |
| OR_LT(_U)   | 258 |
| OR_NE(_U)   | 258 |
| ORP         | 208 |
| ORPI        | 211 |
| ORSTRING_EQ | 722 |
| ORSTRING_GE | 722 |
| ORSTRING_GT | 722 |
| ORSTRING_LE | 722 |
| ORSTRING_LT | 722 |
| ORSTRING_NE | 722 |
| ORTM=       | 992 |
| ORTM>       | 992 |
| ORTM>=      | 992 |
| ORTM_EQ     | 992 |
| ORTM_GE     | 992 |
| ORTM_GT     | 992 |
| ORTM_LE     | 992 |
| ORTM_LT     | 992 |
| ORTM_NE     | 992 |
| OUT         | 219 |
| OUT C       | 227 |
| OUT F       | 231 |
| OUT LC      | 229 |
| OUT LST     | 224 |
| OUT LT      | 224 |
| OUT ST      | 221 |
| OUT T       | 221 |
| OUT_C       | 227 |
| OUTH        | 221 |
| OUTH ST     | 221 |
| OUTH T      | 221 |
| OUT_T       | 221 |

## P

|            |      |
|------------|------|
| PID        | 1041 |
| PIDCONT(P) | 1070 |
| PIDINIT(P) | 1068 |



|                       |      |
|-----------------------|------|
| PIDPRMW(P) . . . . .  | 1075 |
| PIDRUN(P) . . . . .   | 1074 |
| PIDSTOP(P) . . . . .  | 1073 |
| PLF . . . . .         | 242  |
| PLS . . . . .         | 240  |
| PLSV . . . . .        | 1096 |
| PLUS(P)(_U) . . . . . | 270  |
| POW(P) . . . . .      | 926  |
| POWD(P) . . . . .     | 928  |
| PWMH . . . . .        | 1124 |

## R

|                              |      |
|------------------------------|------|
| RAD(P) . . . . .             | 902  |
| RADD(P) . . . . .            | 906  |
| RCL(P) . . . . .             | 591  |
| RCR(P) . . . . .             | 588  |
| REAL_TO_DINT(_E) . . . . .   | 1274 |
| REAL_TO_INT(_E) . . . . .    | 1272 |
| REAL_TO_LREAL(_E) . . . . .  | 1276 |
| REAL_TO_STRING(_E) . . . . . | 1278 |
| REPLACE(_E) . . . . .        | 1384 |
| RET . . . . .                | 564  |
| RFS(P) . . . . .             | 1007 |
| RIGHT(_E) . . . . .          | 1373 |
| RIGHT(P) . . . . .           | 797  |
| RND(P) . . . . .             | 942  |
| ROL(_E) . . . . .            | 1350 |
| ROL(P) . . . . .             | 591  |
| ROR(_E) . . . . .            | 1352 |
| ROR(P) . . . . .             | 588  |
| RS(_E) . . . . .             | 1400 |
| RS2 . . . . .                | 1219 |
| RSET(P) . . . . .            | 954  |
| RST . . . . .                | 234  |
| RST F . . . . .              | 238  |
| R_TRIG(_E) . . . . .         | 1402 |

## S

|                           |      |
|---------------------------|------|
| S.SOCRCVS . . . . .       | 1157 |
| S(P).DATE- . . . . .      | 1001 |
| S(P).DATE+ . . . . .      | 999  |
| S(P).DATERD . . . . .     | 997  |
| S(P).DEVLD . . . . .      | 609  |
| S(P).PIDCONT . . . . .    | 1059 |
| S(P).PIDINIT . . . . .    | 1056 |
| S(P).PIDPRMW . . . . .    | 1064 |
| S(P).PIDRUN . . . . .     | 1063 |
| S(P).PIDSTOP . . . . .    | 1062 |
| S(P).SOCRDATA . . . . .   | 1174 |
| S(P)_DATEMINUS . . . . .  | 1001 |
| S(P)_DATEPLUS . . . . .   | 999  |
| S(P)_DATERD . . . . .     | 997  |
| S(P)_DEVLD . . . . .      | 609  |
| S(P)_PIDCONT . . . . .    | 1059 |
| S(P)_PIDINIT . . . . .    | 1056 |
| S(P)_PIDPRMW . . . . .    | 1064 |
| S(P)_PIDRUN . . . . .     | 1063 |
| S(P)_PIDSTOP . . . . .    | 1062 |
| S(P)_SOCRDATA . . . . .   | 1174 |
| SCJ . . . . .             | 534  |
| SCL(P)(_U) . . . . .      | 676  |
| SCL2(P)(_U) . . . . .     | 682  |
| SEC2DATE(P)(_U) . . . . . | 986  |
| SEC2TIME(P) . . . . .     | 982  |

|                              |      |
|------------------------------|------|
| SEG(P) . . . . .             | 487  |
| SEL(_E) . . . . .            | 1358 |
| SERDATA(P) . . . . .         | 686  |
| SERMM(P) . . . . .           | 690  |
| SET . . . . .                | 232  |
| SET F . . . . .              | 236  |
| SET_BIT_OF_INT(_E) . . . . . | 1311 |
| SFL(P) . . . . .             | 374  |
| SFR(P) . . . . .             | 372  |
| SFT(P) . . . . .             | 247  |
| SFTBL(P) . . . . .           | 386  |
| SFTBR(P) . . . . .           | 384  |
| SFTWL(P) . . . . .           | 390  |
| SFTWR(P) . . . . .           | 388  |
| SHL(_E) . . . . .            | 1346 |
| SHR(_E) . . . . .            | 1348 |
| SIMASK . . . . .             | 549  |
| SIN(_E) . . . . .            | 1323 |
| SIN(P) . . . . .             | 866  |
| SIND(P) . . . . .            | 878  |
| SJIS2WS(P) . . . . .         | 791  |
| SJIS2WSB(P) . . . . .        | 793  |
| SORTD(_U) . . . . .          | 704  |
| SP.DEVST . . . . .           | 611  |
| SP.ECPRTCL . . . . .         | 1176 |
| SP.FCOPY . . . . .           | 647  |
| SP.FDELETE . . . . .         | 644  |
| SP.FMOVE . . . . .           | 652  |
| SP.FREAD . . . . .           | 614  |
| SP.FRENAME . . . . .         | 657  |
| SP.FSTATUS . . . . .         | 660  |
| SP.FTPGET . . . . .          | 1209 |
| SP.FTPPUT . . . . .          | 1203 |
| SP.FWRITE . . . . .          | 630  |
| SP.SLMPSND . . . . .         | 1184 |
| SP.SOCCINF . . . . .         | 1164 |
| SP.SOCCLOSE . . . . .        | 1150 |
| SP.SOCCSET . . . . .         | 1167 |
| SP.SOCOPEN . . . . .         | 1146 |
| SP.SOCRCV . . . . .          | 1152 |
| SP.SOCRMODE . . . . .        | 1169 |
| SP.SOCSND . . . . .          | 1160 |
| SP_DEVST . . . . .           | 611  |
| SPDH . . . . .               | 1138 |
| SP_ECPRTCL . . . . .         | 1176 |
| SPF(P) . . . . .             | 772  |
| SP_FCOPY . . . . .           | 647  |
| SP_FDELETE . . . . .         | 644  |
| SP_FMOVE . . . . .           | 652  |
| SP_FREAD . . . . .           | 614  |
| SP_FRENAME . . . . .         | 657  |
| SP_FSTATUS . . . . .         | 660  |
| SP_FTPGET . . . . .          | 1209 |
| SP_FTPPUT . . . . .          | 1203 |
| SP_FWRITE . . . . .          | 630  |
| SP_SLMPSND . . . . .         | 1184 |
| SP_SOCCINF . . . . .         | 1164 |
| SP_SOCCLOSE . . . . .        | 1150 |
| SP_SOCCSET . . . . .         | 1167 |
| SP_SOCOPEN . . . . .         | 1146 |
| SP_SOCRCV . . . . .          | 1152 |
| SP_SOCRMODE . . . . .        | 1169 |
| SP_SOCSND . . . . .          | 1160 |
| SQRT(_E) . . . . .           | 1318 |
| SQRT(P) . . . . .            | 716  |
| SR(_E) . . . . .             | 1398 |

|                           |      |
|---------------------------|------|
| SRND(P) .....             | 943  |
| S_SOCRCVS .....           | 1157 |
| STMR .....                | 969  |
| STOP .....                | 256  |
| STR(P)(_U) .....          | 750  |
| STRDEL(P) .....           | 810  |
| STRINGMOV(P) .....        | 729  |
| STRINGMOV(P)_WS .....     | 731  |
| STRINGPLUS(P) .....       | 727  |
| STRING_TO_BCD(_E) .....   | 1298 |
| STRING_TO_BOOL(_E) .....  | 1291 |
| STRING_TO_DINT(_E) .....  | 1296 |
| STRING_TO_DWORD(_E) ..... | 1293 |
| STRING_TO_INT(_E) .....   | 1294 |
| STRING_TO_REAL(_E) .....  | 1300 |
| STRING_TO_TIME(_E) .....  | 1303 |
| STRING_TO_WORD(_E) .....  | 1292 |
| STRINS(P) .....           | 808  |
| SUB(_E) .....             | 1335 |
| SUB_TIME(_E) .....        | 1391 |
| SUM(P) .....              | 694  |
| SWAP(P) .....             | 528  |

## T

---

|                          |      |
|--------------------------|------|
| TAN(_E) .....            | 1325 |
| TAN(P) .....             | 870  |
| TAND(P) .....            | 882  |
| TCMP(P) .....            | 995  |
| TEST(P) .....            | 366  |
| TIMCHK .....             | 1005 |
| TIME2SEC(P) .....        | 980  |
| TIMER_100_FB_M .....     | 1422 |
| TIMER_10_FB_M .....      | 1422 |
| TIMER_CONT_FB_M .....    | 1422 |
| TIMER_CONTHFB_M .....    | 1422 |
| TIMER_HIGH_FB_M .....    | 1422 |
| TIMER_LOW_FB_M .....     | 1422 |
| TIME_TO_BOOL(_E) .....   | 1284 |
| TIME_TO_DINT(_E) .....   | 1288 |
| TIME_TO_DWORD(_E) .....  | 1286 |
| TIME_TO_INT(_E) .....    | 1287 |
| TIME_TO_STRING(_E) ..... | 1289 |
| TIME_TO_WORD(_E) .....   | 1285 |
| TO(P) .....              | 1012 |
| TOD(P) .....             | 1021 |
| TOF(_E) .....            | 1420 |
| TON(_E) .....            | 1418 |
| TP(_E) .....             | 1415 |
| TTMR .....               | 967  |

## U

---

|                     |     |
|---------------------|-----|
| UDCNT1 .....        | 963 |
| UDCNT2 .....        | 965 |
| UDINT2DBL(P) .....  | 852 |
| UDINT2DINT(P) ..... | 438 |
| UDINT2FLT(P) .....  | 845 |
| UDINT2INT(P) .....  | 434 |
| UDINT2UINT(P) ..... | 436 |
| UINT2DBL(P) .....   | 850 |
| UINT2DINT(P) .....  | 424 |
| UINT2FLT(P) .....   | 842 |
| UINT2INT(P) .....   | 422 |
| UINT2UDINT(P) ..... | 426 |
| UNI(P) .....        | 492 |

|                   |      |
|-------------------|------|
| UNIINFRD(P) ..... | 1025 |
|-------------------|------|

## V

---

|                  |     |
|------------------|-----|
| VAL(P)(_U) ..... | 471 |
|------------------|-----|

## W

---

|                          |         |
|--------------------------|---------|
| WAND(P) .....            | 327,328 |
| WDT(P) .....             | 552     |
| WOR(P) .....             | 336,337 |
| WORD_TO_BOOL(_E) .....   | 1228    |
| WORD_TO_DINT(_E) .....   | 1231    |
| WORD_TO_DWORD(_E) .....  | 1229    |
| WORD_TO_INT(_E) .....    | 1230    |
| WORD_TO_STRING(_E) ..... | 1233    |
| WORD_TO_TIME(_E) .....   | 1232    |
| WS2SJIS(P) .....         | 789     |
| WSUM(P)(_U) .....        | 708     |
| WTOB(P) .....            | 498     |
| WXNR(P) .....            | 354,355 |
| WXOR(P) .....            | 345,346 |

## X

---

|               |      |
|---------------|------|
| XCALL .....   | 583  |
| XCH(P) .....  | 524  |
| XOR(_E) ..... | 1354 |

## Z

---

|                   |         |
|-------------------|---------|
| ZONE(P)(_U) ..... | 672     |
| ZPOP(P) .....     | 947,952 |
| ZPOP(P)_2 .....   | 952     |
| ZPUSH(P) .....    | 944,948 |
| ZPUSH(P)_2 .....  | 948     |
| ZRRDB(P) .....    | 956     |
| ZRWRRB(P) .....   | 958     |

# REVISIONS

\*The manual number is given on the bottom left of the back cover.

| Revision date | *Manual number     | Description                                                                                                                                                                  |
|---------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| October 2024  | SH(NA)-082691ENG-A | First edition                                                                                                                                                                |
| May 2025      | SH(NA)-082691ENG-B | ■Added or modified parts<br>Chapter 9, Section 13.2, 13.3, 22.1, 27.1, 27.2, 28.1, 28.2, 28.3, 29.1, 43.1, Chapter 44, 45, 46, Appendix 1, CONDITIONS OF USE FOR THE PRODUCT |
| October 2025  | SH(NA)-082691ENG-C | ■Added or modified parts<br>GENERIC TERMS AND ABBREVIATIONS, Chapter 6, 9, 13, 23, 25, 26, 27, 28, 44, 45, 46                                                                |
| April 2026    | SH(NA)-082691ENG-D | ■Added or modified parts<br>Section 17.1, 32.42, 32.44, 32.45, 39.1, 39.2, 39.8, 46.9, 46.10, 46.17, 47.7, 47.8, 47.14                                                       |

Japanese manual number: SH-082690-D

This manual confers no industrial property rights or any rights of any other kind, nor does it confer any patent licenses. Mitsubishi Electric Corporation cannot be held responsible for any problems involving industrial property rights which may occur as a result of using the contents noted in this manual.

© 2024 MITSUBISHI ELECTRIC CORPORATION

# CONDITIONS OF USE FOR THE PRODUCT

---

- (1) MELSEC controller system ("the PRODUCT") shall be used in conditions;
- i) where any problem, fault or failure occurring in the PRODUCT, if any, shall not lead to any major or serious accident; and
  - ii) where the backup and fail-safe function are systematically or automatically provided outside of the PRODUCT for the case of any problem, fault or failure occurring in the PRODUCT.
- (2) The PRODUCT has been designed and manufactured for the purpose of being used in general industries. MITSUBISHI ELECTRIC SHALL HAVE NO RESPONSIBILITY OR LIABILITY (INCLUDING, BUT NOT LIMITED TO ANY AND ALL RESPONSIBILITY OR LIABILITY BASED ON CONTRACT, WARRANTY, TORT, PRODUCT LIABILITY) FOR ANY INJURY OR DEATH TO PERSONS OR LOSS OR DAMAGE TO PROPERTY CAUSED BY the PRODUCT THAT ARE OPERATED OR USED IN APPLICATION NOT INTENDED OR EXCLUDED BY INSTRUCTIONS, PRECAUTIONS, OR WARNING CONTAINED IN MITSUBISHI ELECTRIC USER'S, INSTRUCTION AND/OR SAFETY MANUALS, TECHNICAL BULLETINS AND GUIDELINES FOR the PRODUCT.
- ("Prohibited Application")
- Prohibited Applications include, but not limited to, the use of the PRODUCT in;
- Nuclear Power Plants and any other power plants operated by Power companies, and/or any other cases in which the public could be affected if any problem or fault occurs in the PRODUCT.
  - Railway companies or Public service purposes, and/or any other cases in which establishment of a special quality assurance system is required by the Purchaser or End User.
  - Aircraft or Aerospace, Medical applications, Train equipment, transport equipment such as Elevator and Escalator, Incineration and Fuel devices, Vehicles, Manned transportation, Equipment for Recreation and Amusement, and Safety devices, handling of Nuclear or Hazardous Materials or Chemicals, Mining and Drilling, and/or other applications where there is a significant risk of injury to the public or property.
- Notwithstanding the above restrictions, Mitsubishi Electric may in its sole discretion, authorize use of the PRODUCT in one or more of the Prohibited Applications, provided that the usage of the PRODUCT is limited only for the specific applications agreed to by Mitsubishi Electric and provided further that no special quality assurance or fail-safe, redundant or other safety features which exceed the general specifications of the PRODUCTS are required. For details, please contact the Mitsubishi Electric representative in your region.
- (3) Mitsubishi Electric shall have no responsibility or liability for any problems involving controller system trouble and system trouble caused by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.

# WARRANTY

---

Please confirm the following product warranty details before using this product.

## **1. Gratis Warranty Term and Gratis Warranty Range**

If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the sales representative or Mitsubishi Service Company.

However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

[Gratis Warranty Term]

The gratis warranty term of the product shall be for one year after the date of purchase or delivery to a designated place. Note that after manufacture and shipment from Mitsubishi, the maximum distribution period shall be six (6) months, and the longest gratis warranty term after manufacturing shall be eighteen (18) months. The gratis warranty term of repair parts shall not exceed the gratis warranty term before repairs.

[Gratis Warranty Range]

- (1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.
- (2) Even within the gratis warranty term, repairs shall be charged for in the following cases.
  1. Failure occurring from inappropriate storage or handling, carelessness or negligence by the user. Failure caused by the user's hardware or software design.
  2. Failure caused by unapproved modifications, etc., to the product by the user.
  3. When the Mitsubishi product is assembled into a user's device, Failure that could have been avoided if functions or structures, judged as necessary in the legal safety measures the user's device is subject to or as necessary by industry standards, had been provided.
  4. Failure that could have been avoided if consumable parts (battery, backlight, fuse, etc.) designated in the instruction manual had been correctly serviced or replaced.
  5. Failure caused by external irresistible forces such as fires or abnormal voltages, and Failure caused by force majeure such as earthquakes, lightning, wind and water damage.
  6. Failure caused by reasons unpredictable by scientific technology standards at time of shipment from Mitsubishi.
  7. Any other failure found not to be the responsibility of Mitsubishi or that admitted not to be so by the user.

## **2. Onerous repair term after discontinuation of production**

- (1) Mitsubishi shall accept onerous product repairs for seven (7) years after production of the product is discontinued. Discontinuation of production shall be notified with Mitsubishi Technical Bulletins, etc.
- (2) Product supply (including repair parts) is not available after production is discontinued.

## **3. Overseas service**

Overseas, repairs shall be accepted by Mitsubishi's local overseas FA Center. Note that the repair conditions at each FA Center may differ.

## **4. Exclusion of loss in opportunity and secondary loss from warranty liability**

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

- (1) Damages caused by any cause found not to be the responsibility of Mitsubishi.
- (2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.
- (3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.
- (4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

## **5. Changes in product specifications**

The specifications given in the catalogs, manuals or technical documents are subject to change without prior notice.

# INFORMATION AND SERVICES

---

For further information and services, please contact your local Mitsubishi Electric sales office or representative.  
Visit our website to find our locations worldwide.

MITSUBISHI ELECTRIC Factory Automation Global Website

Locations Worldwide

[www.MitsubishiElectric.com/fa/about-us/overseas/](http://www.MitsubishiElectric.com/fa/about-us/overseas/)

# TRADEMARKS

---

The company names, system names and product names mentioned in this manual are either registered trademarks or trademarks of their respective companies.

In some cases, trademark symbols such as '™' or '®' are not specified in this manual.



SH(NA)-082691ENG-D

## **mitsubishi electric corporation**

HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN  
NAGOYA WORKS: 1-14, YADA-MINAMI 5-CHOME, HIGASHI-KU, NAGOYA 461-8670, JAPAN

When exported from Japan, this manual does not require application to the  
Ministry of Economy, Trade and Industry for service transaction permission.

Specifications subject to change without notice.